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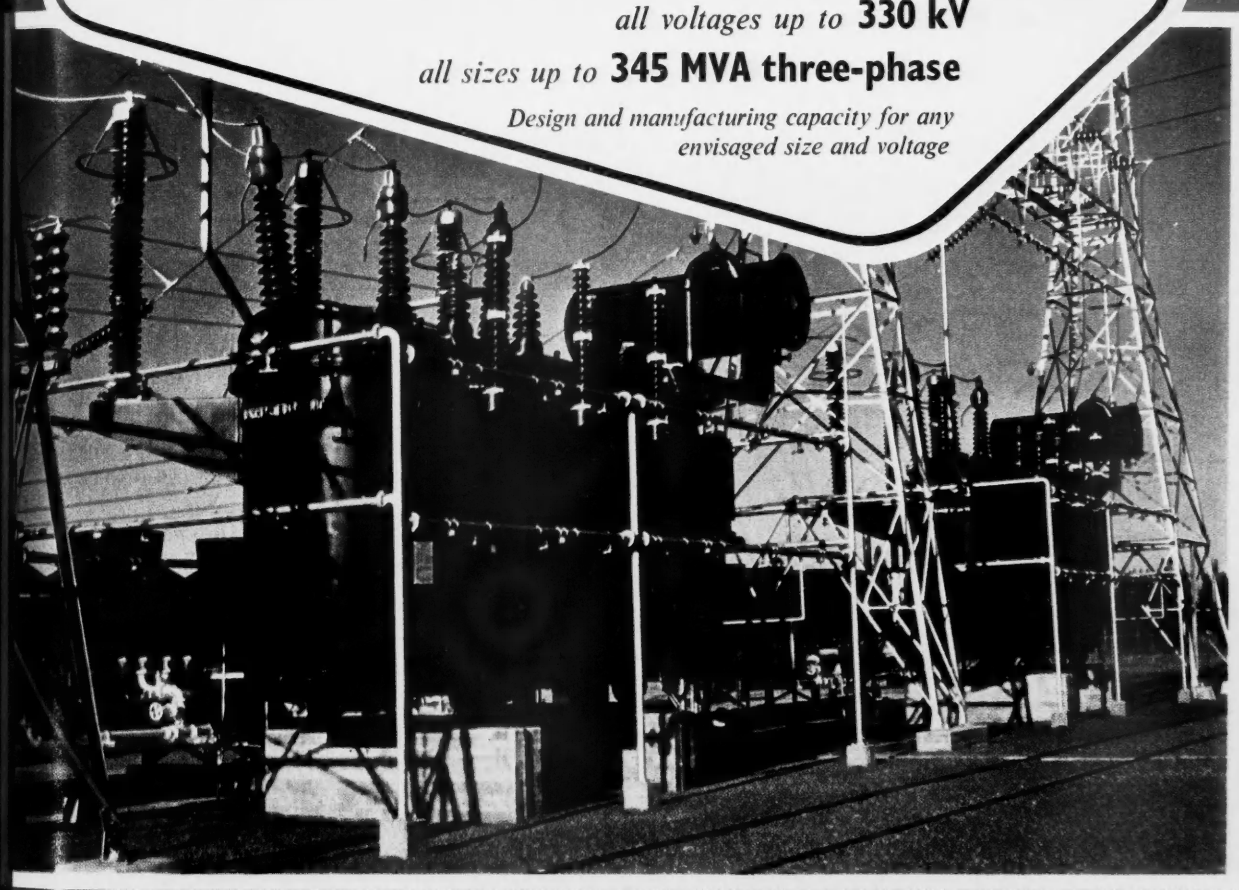

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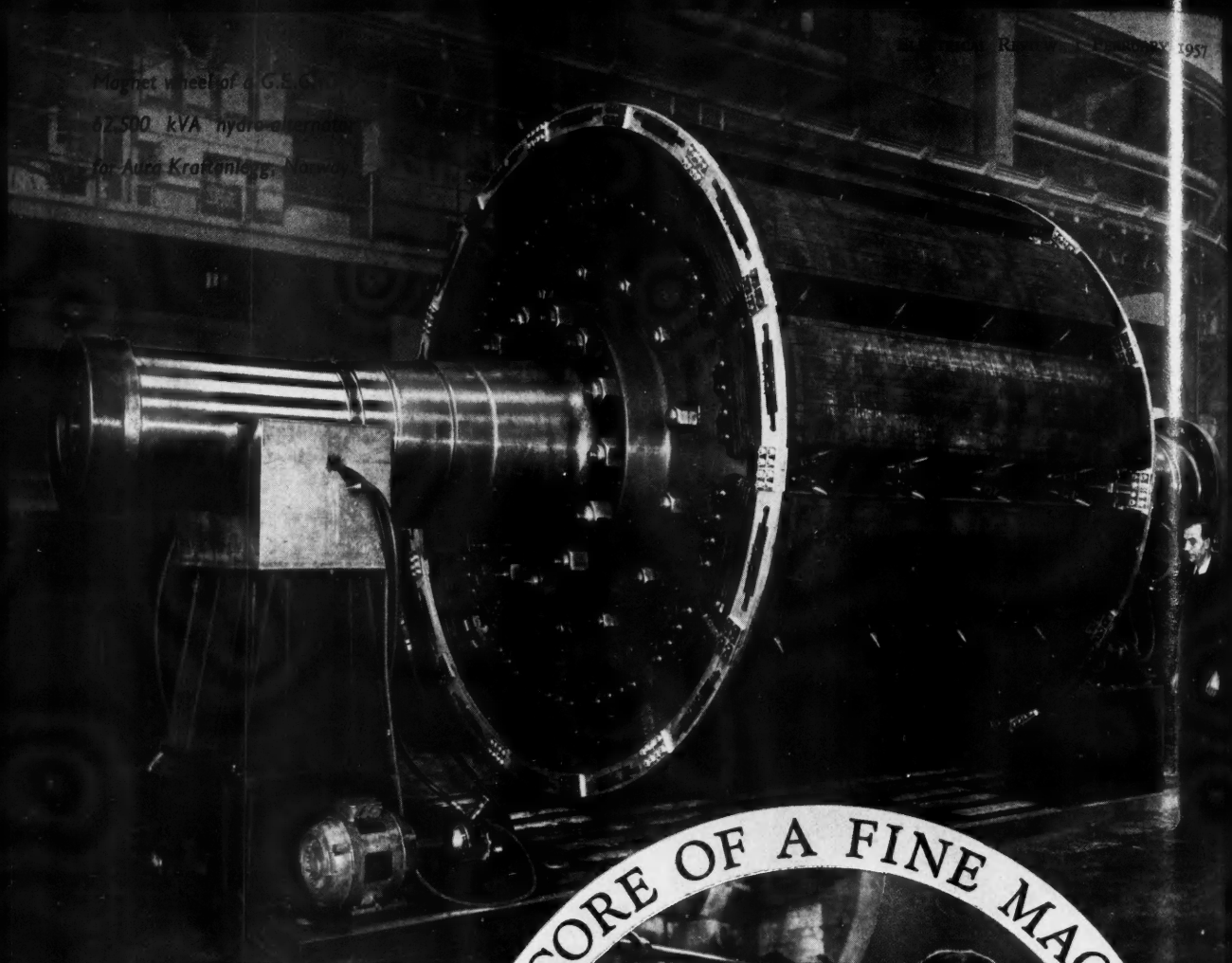

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ELECTRICAL REVIEW

Managing Editor: HUGH S. POCOCK, M.I.E.E. *General Editor:* J. H. COSENS *Technical Editor:* P. W. TUCKER, M.I.E.E.

In This Issue

Factors of Safety	181	Realisation that some margins of safety are too large is leading to a revision of margins and savings in costs
Royal Aircraft Establishment	183	Description of electrical installations and equipment for advanced aeronautical research at Farnborough
Combined Generation	190	The effect of efficiency ratio and superheat for different initial steam pressures is depicted in tabular form
Manufacturing Progress in 1956	204	Ferranti, Ltd., supplied 330 kV transmission transformers for the Kariba hydro-electric scheme in the largest overseas transformer order ever placed with a British manufacturer
Transatlantic Telephone Cable	205	Joint meeting between the Institution of Electrical Engineers, the American Institute of Electrical Engineers in New York and the Engineering Institute of Canada in Montreal, linked by transatlantic telephone cable
Standard A.C. Motors	207	Review of recent developments aimed at standardisation with particular reference to the new range of standard a.c. ventilated motors with Class E insulation
Electric Space Heating	209	Consideration of electricity for space heating in plenum or air conditioning systems

✧ ✧ ✧ ✧

Leaderettes	182	**New Electrical Equipment**	217
Views on the News	193	**Generation and Development**	218
Parliamentary Report	195	**Financial Section**	220
Personal and Social	197	**Next Week's Events**	223
Industrial News	200	**New Patents**	224
Luminescence	214	**Contract Information**	225
Australian Electrical Trade	215	*CLASSIFIED ADVERTISEMENTS*	107
Transistor Applications	216	*INDEX TO ADVERTISERS*	118

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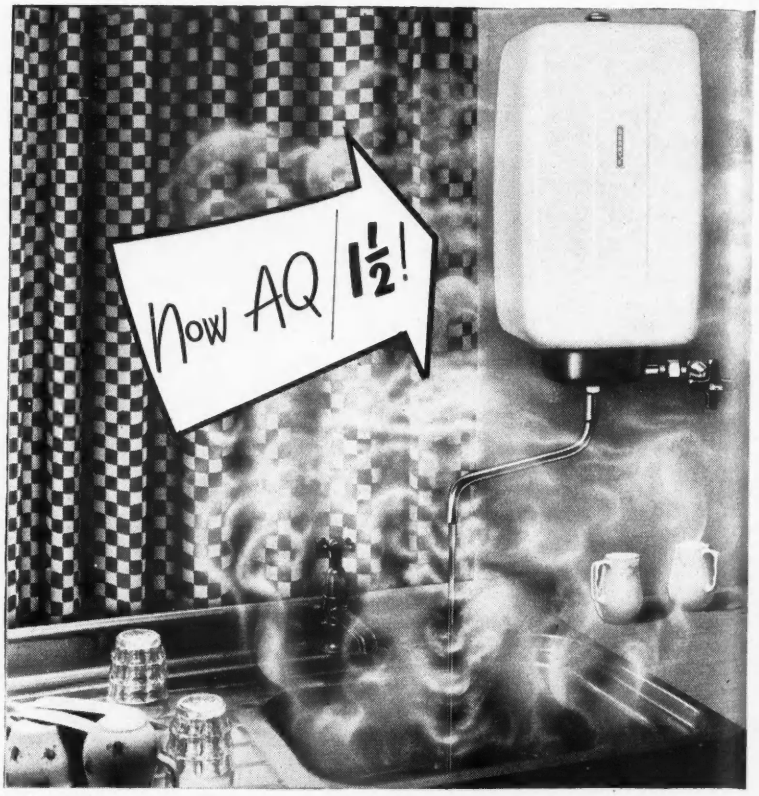

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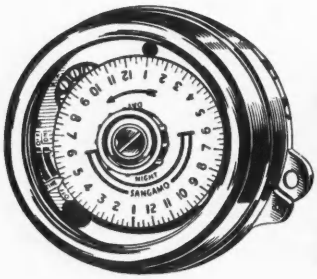

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ELECTRICAL REVIEW

1 February 1957 Vol. 160 No. 5 Established 1872

Factors of Safety

ONE of the most potent influences in lowering costs of engineering structures has been a more exact determination of the margin that should be allowed to cover unforeseen contingencies. Known as the " factor of safety," this margin has been sometimes called the " factor of ignorance," unkindly perhaps, but often more or less correctly, even if unavoidable. It may be that engineering practice, based on deductions from present and past experience, has outstripped applied science in time and that the precautions taken have later proved to be ultra-conservative. In that case the excessive cost of assuring reliability may be reckoned as a development charge and the margin reduced with resulting economy. On the other hand a factor of safety may become fossilised as a tradition.

The two aspects are often almost inextricably mixed and the position further complicated by a latent desire for 100 per cent reliability. That ideal has seldom been achieved by an elaboration of protective measures and a simplicity that aims at something less often achieves its aim better at far less expense. An object lesson in this way is to be found in the layout of the newer distribution substations, under the spur of financial stringency, with the elimination of switchgear, transformers and cables surplus to the real needs of security of supply.

Much of the credit must be given to the greater reliability of modern plant. An instance is provided by the combination of one boiler with one turbine as an independent plant unit, although operating at steam pressures and temperatures greatly in excess of those in use only a few years ago, when in common practice a plethora of boilers connected to a common steam main served a relatively few turbines. An extraneous factor that has encouraged such an advance is that the amount of spare generating capacity once considered as necessary was reduced in a ratio of more than four to one by grid-interconnection of power stations. In high-voltage overhead transmission, material economies are expected from a reassessment of factors of safety—one of the most important subjects discussed at last year's C.I.G.R.E.

Active investigations in hand internationally relate to the effect of wind pressure, which seems to have been grossly overestimated under general conditions in the past, the insulation levels necessary at the highest voltages, and the number of elements, maximum slope and minimum clearance for suspension insulation strings. Taking one instance from industry, the growing inclination to run induction motors at their full rating and overload rating where appropriate brings a saving in capacity that is reflected into the mains in the form of higher power factor. Continuation of the present tendency to question the justification of generally accepted factors of safety, taking advantage of statistical probability of breakdown, provides an outstanding means of countering the effects of rises in price.

POWER CONVENTION PAPERS

The full programme of the British Electrical Power Convention at Eastbourne next June (17th to 21st) is expected to be available in a few days' time. In the meantime enough is known about it for us to assure delegates that they will again have a busy time. Last year there were ten papers as well as the other established features; at Eastbourne, where the theme is to be "Electricity and the National Economy," fourteen will be presented of which ten will be of a technical character. Many people, both in the electrical industry and outside it, have the idea that the Convention is an escape from work for the week. While some who attend may justify this aspersion, for the great majority it is anything but a holiday.

TRANSISTOR POTENTIALITIES

The transistor has only been available for a comparatively short time and in the early days many thought that in its various forms it would soon render the thermionic valve obsolete. Both groups of devices, however, have their applications and it seems that where extremely small size and minimum power consumption are essential, the transistor will come into its own. This applies particularly to portable apparatus, a good example of which is the truly portable high-fidelity gramophone record players which some manufacturers are producing. A transistor audio-amplifier is employed and both this and the turntable motor operate from dry cells, with a life of about 15 hours. In a car radio set the valve heaters impose a heavy drain on the battery and the vibrating reed type h.v. generators are in some cases not as reliable as they might be.

A transistor radio receiver can be made easily and in an I.E.E. paper, the discussion on which is reported in this issue, Mr. F. Oakes describes how transistor-operated power supply units can be designed. It thus seems likely that before long we shall have compact and reliable car radio sets which will impose only a small drain on the battery, which, in recent years, has tended to become far too heavily loaded. Many improvements can also be expected in the field of portable instrument design so that heavy batteries and unwieldy power packs will be done away with.

LIGHTING AND ARCHITECTURE

The paper "Artificial Lighting as an Effective Aid to Architecture," by Messrs. H. E. Bellchambers, R. V. Mills and H. R. Ruff, which was presented to the Illuminating Engineering Society, London, on 8th January, prompts us once again to draw attention to the great importance of obtaining adequate co-operation between the architect and the lighting engineer. The authors point out that from the architect's basic conception of an interior the data required by the lighting engineer to translate this conception into a satisfying installation can be set out. The approach involves an acceptance of the main outline of the architect's "solution" to which are added the requirements for visual comfort and performance. These are accomplished through an interpretation of brightness and colour patterns into light intensities and colour values that can be calculated and measured.

It is suggested that design is stimulated by two major considerations which can form the basis of a design method. These are: (a) the purpose of the building, its relationship to the people who will use it and the way in which it is used; (b) the character of the building interior. The architect's problems concern the specification of his requirements in terms that can be interpreted by the lighting engineer, while the engineer's problems relate to the determination of illumination and colour values, using methods of sufficient accuracy for the purpose which are not too time consuming.

OUTSTANDING ACHIEVEMENT

A major repair job recently completed at Brighton "B" power station must constitute something of a record. The work, as described in the January issue of *Electricity* (C.E.A.), involved the complete re-blading of the turbine rotors of three 55·5 MW turbo-alternator sets, with the exception of the first six rows on the h.p. spindles in each case.

Some 16,000 blades were manufactured, more than 15,000 were actually fitted, and 30,000 individual tests for evidence of cracking were carried out in a period of seven months—an excellent example of what can be achieved by detailed planning and co-ordination of all phases of the work, coupled with the high sense of urgency and service which was displayed by the turbine manufacturers, Richardsons Westgarth, and the designers, Brown Boveri.

INTERNATIONAL TEAMWORK

One is accustomed to the readiness of engineers in all countries to pool their technical knowledge at international conferences, very much to their mutual benefit. Fewer opportunities are afforded them to work together internationally to give practical shape to the diversity of their experience, although some developments in Europe have paved the way to bigger things. An Anglo-French high voltage power link would also furnish a notable instance of what is possible in such co-operation. The outstanding example of what has already been done is the laying of the first transatlantic telephone cable. From the international symposium held last week at the Institution of Electrical Engineers it appears evident that the multitudinous components were selected, irrespective of the country of origin, with the single-minded object of using those most suitable for the work.

ELECTRIC IRONS

The next in our series of illustrated surveys of domestic electrical appliances will deal with electric irons (8th February issue). Particulars will be given, in tabular form, of the type, loading, weight, finish, price, purchase tax and special features. In the next survey (1st March) we shall deal with electric kettles and coffee percolators

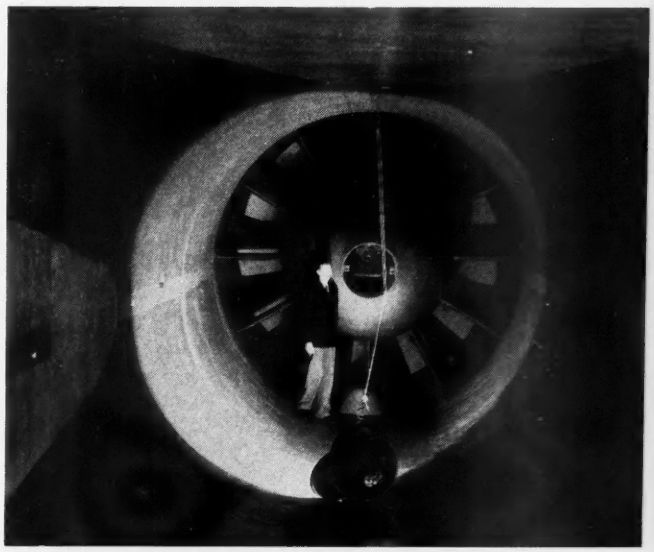
Royal Aircraft Establishment

SOME INTERESTING ELECTRICAL INSTALLATIONS AT FARNBOROUGH

THE Royal Aircraft Establishment at Farnborough, Hants, is in the news every year on the occasion of the annual display of the Society of British Aircraft Constructors. Less well known to the public is the enormous amount of research and development work carried out there by the Ministry of Supply, involving some intricate electrical installations and the consumption of large quantities of power.

Some indication of the size of the establishment is given by the figures of 7,000 people employed there and a maximum demand of 20 MVA. The system is supplied from the grid which feeds the 33 kV main substations of the R.A.E., as shown in Fig. 1. There are three of these, two in the main area and one on the airfield, and all are equipped with Reyrolle 750 MVA, 33 kV oil circuit-breakers.

A total of 45 MVA of 33 kV transformer capacity is installed; in the main area h.v. distribution is at 6·6 kV, and on the airfield at 11 kV. A power station of 7,500 kW capacity in the main area, containing motor generators, motor convertors and turbo-generators, is used to provide d.c. power to a number of test rigs among which are two airscrew spinning towers of 3,780 h.p. and 1,500 h.p. respectively, a series of 500 h.p. blower motors, 250 h.p. and 150 h.p. vacuum pump motors, and a variety of wind tunnel drives.



Above: Reyrolle 33 kV switchgear in one of the main substations

Above right: 12,000 h.p. of motors drive this fan in the transonic wind tunnel

It is hoped later that the 275 kV grid system will be tapped at Fleet and a 132 kV supply brought direct into the Establishment. This is especially necessary in view of the rapid development of a kinetic heating laboratory where research can be done on the effect of heat on aircraft structures, etc., such as will be encountered in the so-called "heat-barrier" at very high speeds. At present, a 1,000 kW installation is being built using special high intensity heaters developed by Philips, but a future plant of 60,000 kW size is envisaged, needing special supply arrangements.

An installation just completed, and at present the biggest single user of electrical power, is that of a large transonic testing plant—the 8ft by 6ft wind tunnel, preliminary running of which has shown that a Mach number of over 1·2 is reached in the air stream. This is actually a modification of the well-known 10ft by 7ft

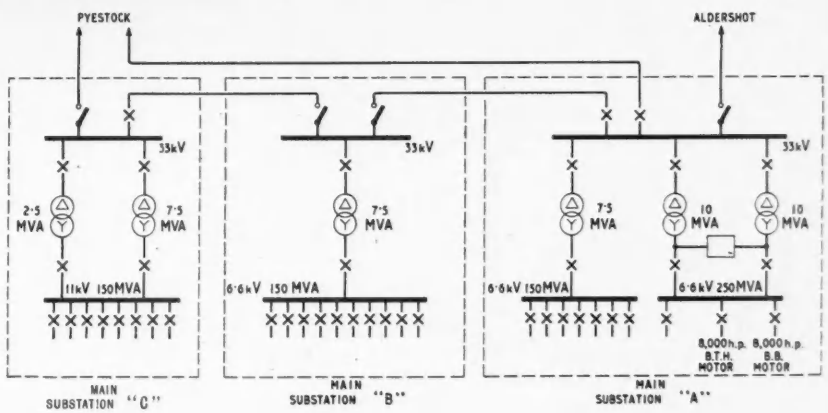


Fig. 1: Basic distribution system at the Royal Aircraft Establishment, Farnborough

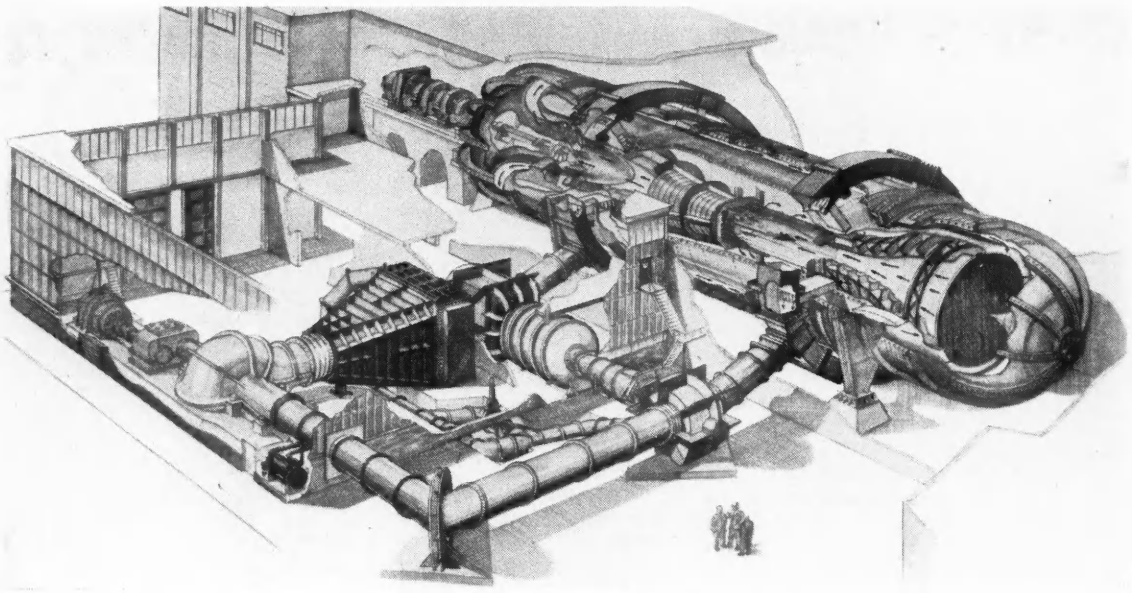


Fig. 2.—Simplified arrangement of the transonic wind tunnel

"high-speed tunnel," the total power of the installed machinery having been increased fivefold.

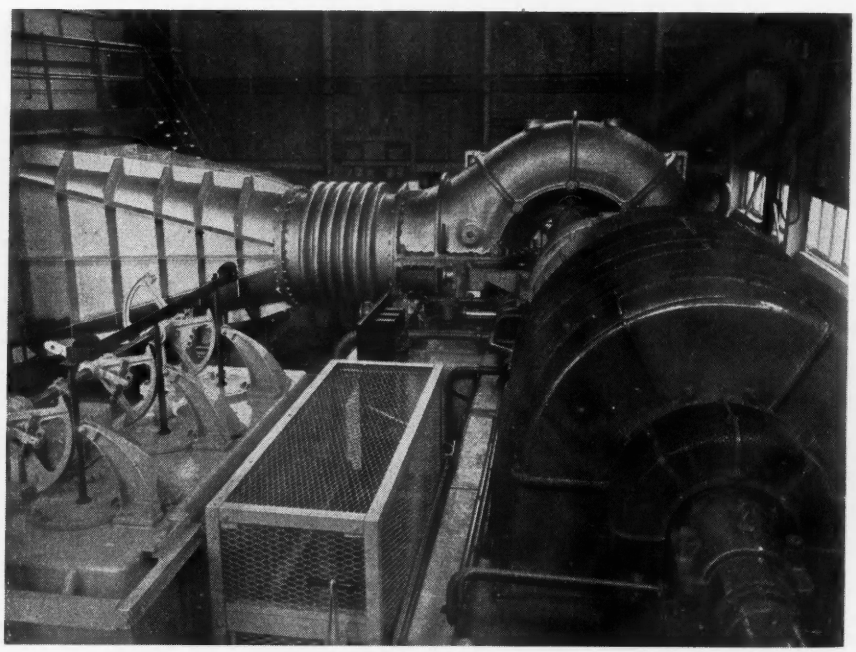
The scope of model testing in the tunnel has been extended in two main respects. "Choking," which limited the earlier kind of high-speed wind tunnel to about Mach 0·95, has been overcome by use of a transonic working section, allowing test work to be carried out through the speed of sound and beyond. It has "ventilated" walls, air being extracted through them by a new 8,000 h.p. axial blower. After being compressed, the extracted air is put back into the air stream. Transonic testing by a somewhat similar process has been possible for some time past in the 3ft by 3ft tunnel at the R.A.E., Bedford.

The second big improvement is the addition of a new motor to the main fan drive, increasing the power from 4,000 h.p. to 12,000 h.p. This is to allow testing to be done at higher air pressure, giving a larger "Reynolds number" and a closer approach to the aerodynamic conditions of flight. As in its previous form, the tunnel is capable of being pressurised or evacuated and can be used over a range of pressures from about $3\frac{1}{2}$ atmospheres to $\frac{1}{10}$ atmosphere absolute. In normal operation the tunnel will be used pressurised for subsonic testing and will be evacuated to about $\frac{3}{4}$ atmosphere for transonic work.

In most wind tunnels the model should be observable, both as a safety measure and for experiments in which the air flow is rendered visible. In this tunnel the main structure and new working area are such that direct viewing is difficult, and so special closed-circuit television equipment is installed. The cameras are inside, looking at the model under test through the working section walls, while the screens are in the operating desk in the control room.

The basic design of the wind tunnel is seen in Fig. 2. The original fan drive consisted of two 2,000 h.p. d.c. motors supplied by nearby motor-generator sets. The fan used is unchanged but an 8,000 h.p. induction motor

Brown Boveri 8,000 h.p. motor driving axial compressor. In the left foreground is the variable liquid resistance used for starting and speed control



has now been coupled to the existing d.c. drive, making a unique installation. Although the maximum speed is unchanged the weight of air that can be driven is now much greater, permitting the use of higher pressures inside the tunnel. All this driving plant is of B.T.H. manufacture and design.

The tunnel load characteristic is such that up to about 350 r.p.m. power is provided solely by the two d.c. machines. These are supplied from a conventional Ward-Leonard system operating with variable armature voltage. The generator fields are controlled by a power-operated rheostat coupled to a pilot rheostat which, in turn, sets the reference voltage for an electronic speed regulator. This voltage, which is obtained from a stabilised source, is compared with the output from a high accuracy tacho-generator coupled to the main drive. The signal error is amplified and used to control the output of thyratron valves which supply an auxiliary field on the generators. By use of this high gain system the speed is maintained within ± 1 r.p.m. for load changes of ± 5 per cent. Transient feedbacks from generator voltage and motor current are used to prevent hunting of the regulator.

At about 350 r.p.m. the induction motor is switched on with its liquid rotor resistance at maximum value. Above 350 r.p.m. the speed of the fan drive is varied by weakening the d.c. motor fields and thus a consistent h.p. drive is provided.

To maintain the d.c. loading constant, a voltage signal is obtained from a d.c. current transformer in the motor armature circuit which is compared with a fixed reference voltage. Any error signal is amplified by a high gain electronic amplifier and fed into the field of a small Ward-Leonard generator. The motor of the Ward-Leonard set drives a differential conical drum which operates the electrodes of the liquid rotor resistance.

A call for an increase in speed, by movement of the power-operated rheostat, or a change in tunnel loading, results in an immediate increase in current which causes the liquid resistance electrodes to move to reduce the rotor resistance, causing the a.c. motor to take more load whilst the loading of the d.c. motors remains constant. Current limiting is applied to the d.c. motors to prevent overloading during transient conditions.

Compressor Unit

Extraction of air through the ventilated walls is by an 8,000 h.p. Brown-Boveri compressor unit. Two rings of trunking encircle the main part of the tunnel, at either end of the working section. One of these has several ducts to the space surrounding the working section of the tunnel and air is drawn through longitudinal slots around the working section, through these ducts, through the compressor and back into the tunnel return circuit. This will be best understood by reference to Fig. 2.

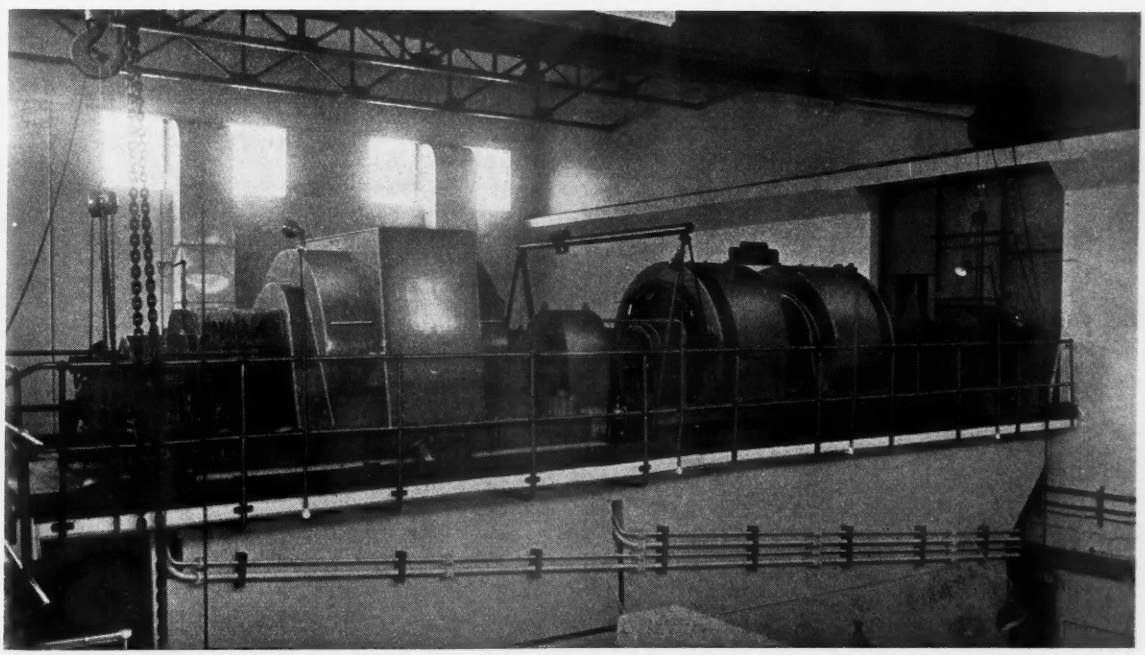
The compressor set consists of a 12-stage single-flow uncooled axial compressor driven through single helical gearing by a three-phase six-pole asynchronous motor. The compressor is required to deliver 240,000 cu ft/min of air from inlet conditions of 55 deg C and 414 lb/sq in abs., compressing to a delivery pressure of 12·1 lb/sq in abs., i.e. a pressure ratio of 2·75. For these conditions the compressor requires 4,830 kW at the coupling. The speed of the compressor for maximum duty is 2,805 r.p.m. and the rating of the 968 r.p.m. motor is 6,000 kW.

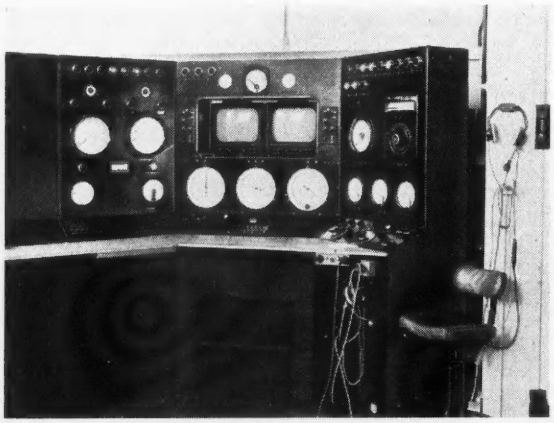
The air from the compressor delivery branch has a temperature of approximately 180 deg C, and this is reduced to approximately 35 deg C, by passing the air through an aftercooler before it goes to the return circuit of the tunnel.

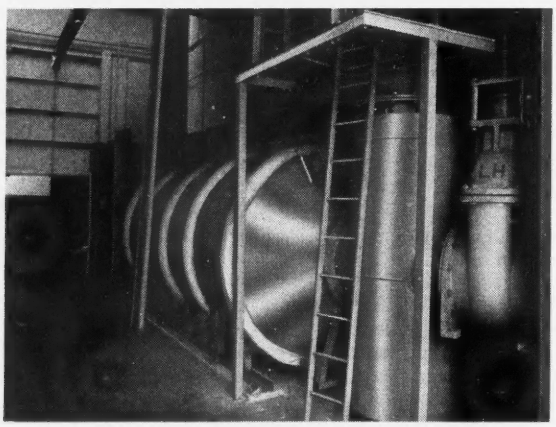
A starter of the liquid resistor type starts the main motor, and for use with this starter there is a separate electrolyte circulating pump and coolers which are in operation continuously whilst the set is running.

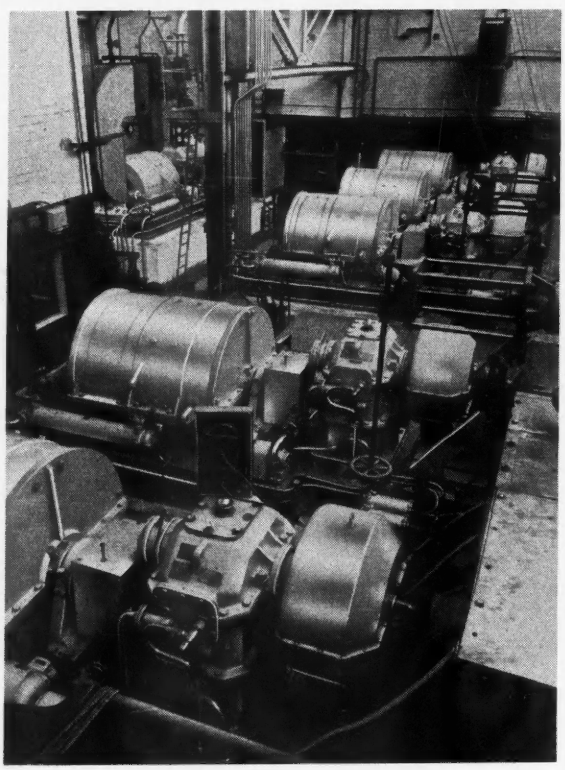
To protect the compressor a 600 mm "anti-surge" butterfly valve in a by-pass duct is provided which closes under oil pressure and opens under pressure failure, assisted by spring loading. This ensures that if the electrical power or oil pressure fail, the valve will open.

Drive for the main fan seen in the title block. The new 8,000 h.p. motor is on the left and the old twin 2,000 h.p. d.c. motors are on the right









To actuate the anti-surge valve, a Foxboro pressure ratio controller is used which measures the pressure difference across the aftercooler against the delivery pressure at the compressor delivery branch so that should there be any tendency for the compressor to surge the anti-surge valve opens and relieves the compressor outlet pressure.

Air sucked from the tunnel is controlled by regulating the speed of the motor and by varying the opening of a second valve, the "by-pass" valve in the by-pass duct. This valve is used as the operating control but in order that it may be effective it is necessary that the motor speed, once set, shall not alter, and so automatic speed control is provided. This works in conjunction with the liquid starter and consists of an electric frequency measuring device acting through a servo-motor to adjust the position of the electrodes in the starter. Provision is made for hand or automatic control, depending on the requirements of the tunnel operating staff.

Design of the speed control equipment is such that a voltage drop of 5 per cent will cause a momentary speed drop of only 0·3 per cent and this will be corrected to a new mean speed in about 10 sec. The accuracy of the frequency regulator alone, however, is somewhat greater than this.

Upstream of the aftercooler a delivery and non-return butterfly valve is used, 55in in diameter. It is hydraulically opened and should the oil pressure fail the valve is automatically shut by a closing weight.

As the compressor is intended to operate at sub-atmospheric pressures it is necessary, in order to guard against in-leakages of wet air, to seal the glands of the compressor, and for this a separate compressor set supplies dry sealing air to both the suction and delivery side glands; air for this purpose is taken from the main compressor discharge.

When the tunnel is in use the walls are cooled by large quantities of cooled brine circulating through pipes on the walls.

To deal with the large single load involved in this tunnel reconstruction two 10 MVA transformers were installed in the main substation "A" with an additional set of 6·6 kV switchgear, of 250 MVA breaking capacity against the 150 MVA already in use elsewhere. From this switchboard power is supplied to the motor-generator sets for two further 2,000 h.p. motors, driving a smaller high-speed wind tunnel, situated in the same room as the B.T.H. d.c.-a.c. drive for the transonic tunnel. All switchgear is controlled from a small central control room, shown in one of the photographs, with a Reyrolle control panel.

The high altitude test plant is another complex maze of mechanical and electrical services. What might be described as an exhaust "busbar" system runs throughout buildings in which there are six supersonic tunnels capable of dealing with speeds up to Mach 5 and six "combustion rigs" for the testing of combustion chambers, ramjet experiments, etc. All these are of comparatively small size.

To provide exhausting facilities there are three ex-German units, two of 750 kW and one of 400 kW,

Top: Control and observation panel for the transonic wind tunnel. The fan and axial compressor motors can be controlled from here and closed circuit television observes the model in the working section

Centre : A 1,500 kW electric heater which can be used to warm the pressure air in the high altitude test plant air system

Foot : Motors and gearboxes driving Hercules aircraft type blowers for pressure air supplies to high altitude test plant

running in series and in parallel with these are eighteen Nash-Hytor vacuum pumps, ten in tandem driven by 250 h.p. motors and eight single units driven by 150 h.p. motors. Very extensive refrigerating plant is also provided so that the air in the "bus" can be supplied at the desired temperature and humidity and there is an elaborate chemical drying system on the roof of the building. The combined effect of the exhausting plant described is to move up to 35 lb of air per second.

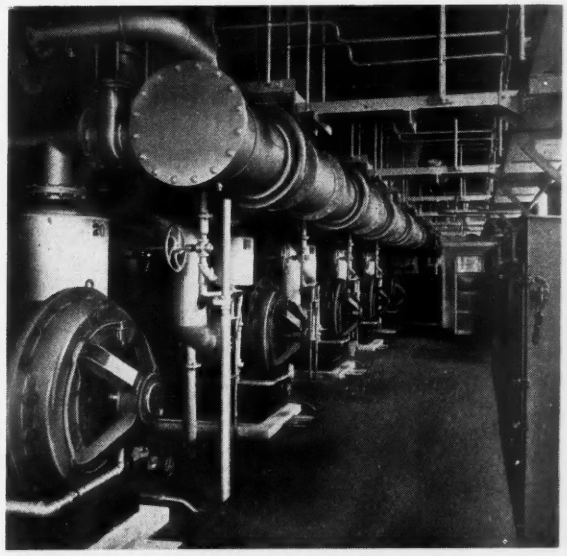
A number of Hercules aircraft superchargers were acquired some time ago and these are coupled to 500 h.p. motors and can each provide 5 lb of air per second, with a 25 : 1 pressure ratio. These are used to pressurise the system. A 1,500 kW heater unit containing expanded metal elements can be inserted in the air stream if heating is required. Another pressure system is based on two ex-German Jaeger compressors, and delivers 10 lb of air per second at 5 : 1 pressure ratio through a complicated system of dryers. This air can also be expanded through three Brown-Boveri turbines to provide an alternative supply of low temperature and low humidity air.

Supersonic Wind Tunnel

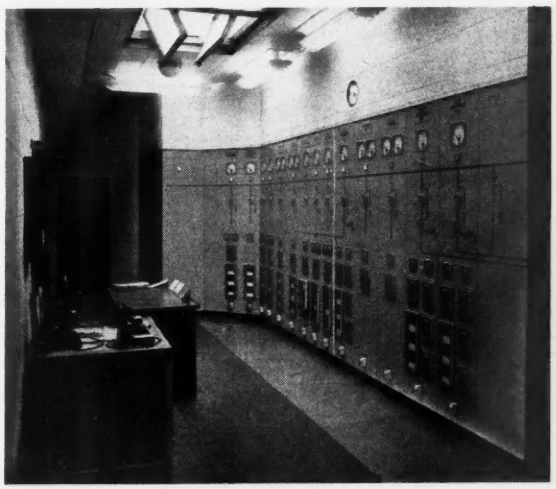
On the other side of the airfield from the main group of buildings at Farnborough, is the Ball Hill wind tunnel used for supersonic testing over the range Mach 1·4-2·2. This has a working section 18in square and is driven by a 7,000 h.p. 3,000 r.p.m. Metropolitan-Vickers synchronous motor, supplied at 11 kV, directly coupled to an Escher Wyss variable pitch axial compressor, having seven stages, and a pressure ratio of 1·1-2·3.

Varied conditions inside the tunnel are achieved with the help of a 240 h.p. Alley & McLellan/Laurence Scott compressor. The maximum pressure in the tunnel shell is 2·8 atm. The auxiliary compressor delivers air up to 100 lb/sq in into a pressure receiver from which the tunnel pressure is adjusted. There are also three Hick Hargreaves/B.T.H. 100 h.p. evacuators capable of providing a degree of vacuum in the tunnel equivalent to 0·15 atmosphere.

In the working section of this tunnel where strain gauges are extensively used in test measurements, the output from these is automatically balanced on bridge circuits and amplified and the results are recorded by an electric typewriter and a punched card machine. The same applies to readings from the manometers. The punched cards are for use in conjunction with the "DEUCE" electronic computer used to evaluate results. This system has speeded up readings to such an extent

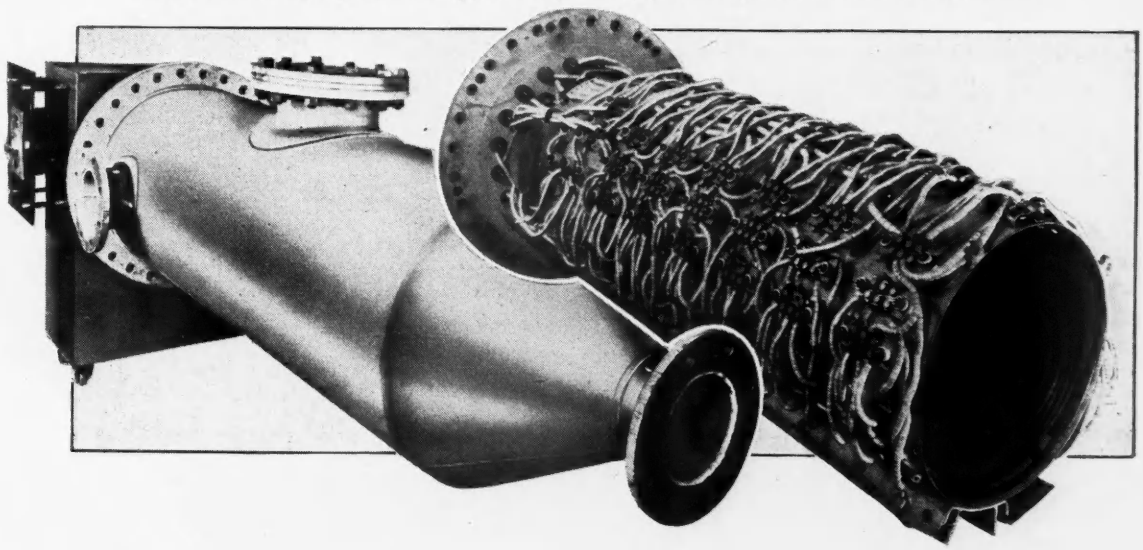


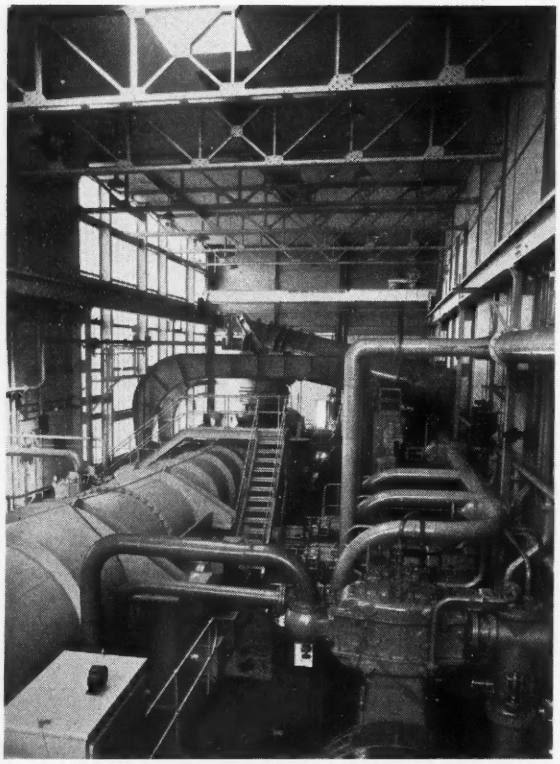
Main suction plant of the H.A.T.P. installation. Five tandem Nash-Hytor vacuum pumps can be seen on the left



Control room for a section of the R.A.E. distribution network

G.E.C. 180 kW heater designed for working pressures up to 75 lb/sq in, showing the internal and external construction





Supersonic wind tunnel at Ball Hill. The driving motor and compressor are in the left background and the working section is on the other side of the wall on the right

that those for one experimental speed test, for instance, can now be taken in about a day instead of a week as before.

Among other items at Farnborough which are of interest is the old 24ft diameter wind tunnel which was built before 1935 and is still in use. This has a 2,000 h.p. d.c. drive from an m.g. set. An example of a more recent specialised installation is that for checking the efficiency of aircraft cooling turbines.

If piloted aircraft are to attain higher supersonic speeds and fly at higher altitudes, it is essential to ascertain the efficiency of turbines cooling the aircraft equipment and cabin under the proposed conditions. On these cooling turbines depends not only the efficient operation and safety of the aircraft but the comfort and life of the pilot. In a jet aircraft, the cooling turbines are operated from air tapped from the jet engine compressor. This air is passed through a ram air heat exchanger before working the turbine which supplies cooling air at about 0 deg C to the cabin and equipment. The temperature as well as the flow pressure of this tapped air will, of course, vary according to the atmosphere at the flying altitude and the speed of the plane, but in a high-speed aircraft will in any case be in excess of 200 deg C.

Pressurised Heater

These differing conditions obviously affect the efficiency of the cooling turbine. To discover what that effect will be, and to gauge the requirements for cooling turbines in a proposed new jet aircraft flying at higher speeds and altitudes, test equipment providing delivery air from a simulated jet engine compressor tapping has been built in the supersonic plant area of the R.A.E. The first requirement for this equipment was a heater capable of raising the temperature of air passing through it from 30 deg C to something in excess of 200 deg C. A heater supplied by the General Electric Co., deals with an air flow of up to 1,150 cu ft/min and withstands a normal working pressure of up to 75 lb/sq in. It contains some 900ft of solid drawn sheathed wire elements and has a total loading of 180 kW.

Although the air to be heated passes through an oil separator special precautions have been taken in the design of the heater to meet the possibility of oil from the compressors entering the heater and setting up an explosive mixture of volatilised oil and air. The heater casing has been built to withstand an internal pressure of 150 lb/sq in with atmospheric pressure on the outside. A feature of the heater design is that the elements can be removed without dismantling the entire equipment. They are arranged in flat spirals housed within a steel cylinder made up of sections bolted together. Each spiral consists of three elements giving a loading of 5 kW and six spirals are housed in each section.

In the scope of an article such as this it has, of course, been possible to touch upon only some of the fascinating items of plant and work at the R.A.E., many of which are in any case under security restrictions. The heavy research plant section of the Ministry of Works was responsible for the design and installation of a large proportion of the plant described in this article. Acknowledgment is due to the Ministry of Supply and to the Director of the Royal Aircraft Establishment for their co-operation and to the British Thomson-Houston Co., Ltd., and British Brown-Boveri, Ltd., for their assistance in the preparation of this article.

Steel-Cored Aluminium Conductors

THE latest edition of the twenty-three-year-old British Standard for aluminium and steel-cored aluminium conductors for overhead power transmission purposes, B.S. 215:1956, is divided into two separate self-contained parts. The first part deals with aluminium conductors for overhead power transmission, while the second covers steel-cored aluminium conductors for the same purposes. Each part contains all the main provisions and details previously specified for the appropriate kind of conductor, but the number of standard sizes has been reduced and the new lists contain some sizes which did not appear in the 1934 edition.

The amendment published in 1952 to provide for changes in manufacturing technique has been incorporated in this edition with some further modifications which have since been found desirable. A wrapping test replaces the elongation test for aluminium wires, and the wrapping test for steel wires is now the same as that specified in B.S. 2763 for steel rope wire. The procedure for sampling and testing has been revised.

In previous editions of B.S. 215 the maximum resistance of each size of aluminium wire was specified. In this revision the maximum resistivity of the material is specified and is the standard value on which world agreement has been reached by the International Electrotechnical Commission. The values of other physical constants of aluminium and of steel-cored wire given in this new edition have also been agreed or provisionally agreed by the Commission.

Appendices give information on the strength of stranded and composite conductors and on modulus of elasticity and coefficient of expansion. A new feature in each part is a list of commercially accepted code names for use in ordering British Standard conductors. Copies of this standard may be obtained from the British Standards Institution, 2, Park Street, London, W.1, price 3s 6d.

Special Steels and Power Generation

Turbine Blading Conditions and Creep Research

SOME interesting information regarding the metallurgist's contributions to electric power generation was given by Dr. Charles Sykes, C.B.E., F.R.S., in the fifth Harold Wright Lecture, which he delivered recently to the Cleveland Scientific and Technical Institution.

He said that since 1947 the steam temperature used in the generating plant installed in British power stations had increased from 850 deg to 1,050 deg F, carbon steel being used for the pipes and superheaters at the lower figure with additions of 2¼ per cent chromium-molybdenum for 1,000 deg and of 2¼ per cent molybdenum and vanadium for 1,050 deg F. The working conditions at these last two figures formed the border line for the low alloy steels and as the trend towards higher temperatures continued the use of austenitic steels would become more general. Much welding had to be done during the assembly of steam pipes on site and this had to be more carefully controlled with high alloyed than with plain carbon steels.

Operating conditions for the turbine blading varied considerably throughout the set. At the high-pressure end the blades were short and relatively lowly stressed so that the designer was concerned primarily with the creep strength of the material. At the low-pressure end the temperatures were low, the blades long and the peripheral speeds high, so that high mechanical strength and good fatigue properties were required. Throughout the blading should resist corrosion. Ordinary stainless iron had satisfactory properties at the outlet end and also adequate creep properties for high-pressure stages operating up to 900 deg F. Beyond that figure improved creep properties could be obtained by using molybdenum or molybdenum-vanadium steels.

Rotor Shaft Material

The rotor shafts in the high-pressure and low-pressure cylinders were usually made of different materials to suit the different temperature conditions. That for the high-pressure rotor would generally be chosen with regard to its strength at elevated temperatures and that for the low-pressure rotor for its mechanical properties at room temperatures. The low-pressure shafts might be either solid forgings or consist of an alloy steel wheel shrunk on to a carbon steel shaft. As sizes and temperatures increased the former was being favoured as it eliminated the problems associated with shrink fit. With 100 MW sets running at 3,000 r.p.m. the centrifugal stresses at the bore of the shaft were considerable and strong uniform forgings had to be employed. Alloy steels were also generally used for the shafts of the larger alternators since these had both good physical and good magnetic properties.

Research into the creep strength of steels had made a major contribution to these developments in power generation. Unfortunately it was not possible to predict what the creep properties of material would be from its chemical composition. Moreover, the precise way in which the varying alloying additions made to the iron improved the creep strength was not known. Metallographic methods had been employed in an attempt to correlate microstructure with creep performance, but it seemed that the distribution and sizes of precipitates, too small to be examined by the normal metallurgical microscope, might act as important factors in controlling the creep rate.

The designer limited the changes in dimensions he expected would occur in certain parts of the turbine with time, on the basis of creep data, to a value which would not exceed the clearances. It was desirable, however, that other changes for which he normally did not make allowance should not take place. For instance, a number of carbon-molybdenum steel shafts which ran quite smoothly when cold had developed out-of-balance effects and vibration at operating temperatures, owing to the fact that lack of uniformity in heating at the normalising temperature and non-uniform air cooling had caused irregularities in the metallurgical structure round the shaft.

Future Trends

As regards future trends studies were now being made for operating conditions of 1,100 deg and 1,150 deg F with pressures of 4,200 lb and 2,400 lb per sq in, respectively. Suitable complex austenitic steels for steam pipes existed which could be fabricated into tubes, but there were a number of welding problems to be solved before they could be used. Superheater tubes and turbine blading should present no serious problems in these special steels, although the higher temperatures would demand higher creep strength and an improved resistance to oxidation. This would mean an increased employment of both the martensitic and austenitic stainless steels for bolts and valves.

Low-pressure turbine and alternator shafts would probably become heavier and larger. Present materials of the molybdenum-vanadium type did not possess adequate creep strength or oxidation resistance for operation as high-pressure shafts at 1,100 deg F and above. Two possibilities were the use of the complex 12 per cent chrome martensitic steels containing columbium and nitrogen or the highly alloyed austenitic steels. In the case of the former material information was required as to the transverse ductility in large forgings, while the latter were very expensive and difficult to produce. Perhaps the simplest solution would be to use a small austenitic rotor to take over the steam range down to 1,050 deg F and to employ conventional materials for the rest of the turbine.

D.S.I.R. Grants

A NEW edition of "Notes on Department of Scientific and Industrial Research Grants for Graduate Students and Research Workers" (H.M. Stationery Office, price 1s 3d) includes further details of the revised arrangements for post-graduate studentships in science and technology first announced early in November.

Provided sufficient candidates of suitable standard are forthcoming, the D.S.I.R. will award in 1957 about 700 research studentships (formerly known as maintenance allowances) and about 200 advanced course studentships. The values of the studentships will be increased in many cases on 1st October next. The booklet also gives details of D.S.I.R. research fellowships and grants for special researches.

Combined Generation

Power and Process Steam Plant

By C. H. FIELDING, B.Sc.Tech., A.M.I.Mech.E.

STEAM has a wide variety of uses for process work where temperatures are not too high. Below about 150 lb/sq in (358 deg F) it is very useful as a heating medium. For space heating, water heating and the like, the steam pressure need not be above 5 to 10 lb/sq in. By employing a higher steam pressure and expanding the steam through a turbine, electricity may be generated as well. Where steam is used as a heating medium the condensate should be returned, otherwise this condensate loss will have to be made up. The condensate will probably have to be returned to a receiving vessel maintained under a vacuum to overcome pipe friction and supply any siphonic head, as the traps will not have sufficient left to effect a return themselves. A pump will be required to transfer the condensate from the vessel to the hotwell.

Type of Turbine

The turbine used may be either of the pass-out or extraction type. In the former, the turbine exhausts direct to the process main, and is a cheaper proposition as it does not require a condenser or auxiliary pumping plant. It does lack flexibility, however, since the electricity generated is strictly proportional to the steam passing through the turbine, that is, the process demand. Where the undertaking is working in parallel with the Central Electricity Authority this may not be of importance, but when worked on a plant independent of the Authority it may be a disadvantage.

It is usually very difficult to achieve an exact balance between electrical and steam demands and therefore an extraction type turbine can be employed. This is fitted with a condenser and auxiliary pumping plant. Valve gear at the appropriate pressure stage controls the spill-over to the condenser. With this type of turbine, the steam quantity extracted can be varied over a wide range, and gives considerable flexibility as regards electricity and extraction steam quantities. It is more costly, obviously, than the straight pass-out type.

In processes using steam, superheat is not required, the best results being achieved if the steam is just "dry saturated." It is desirable, however, to have a small quantity of superheat leaving the turbine to prevent condensation in steam lines. It is this factor which determines the superheat at the turbine stop valve, and usually combined generating plants will have less superheat at the turbine stop valve than in a straight generating plant. The efficiency ratio of the turbine also has a decisive effect on the amount of superheat available at the extraction point.

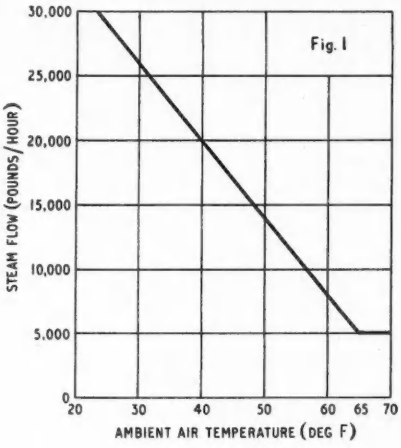
Space heating in combination with water heating can be effectively supplied by steam, although, of course, the space heating is seasonal, being high in the depth of winter and low in summer time.

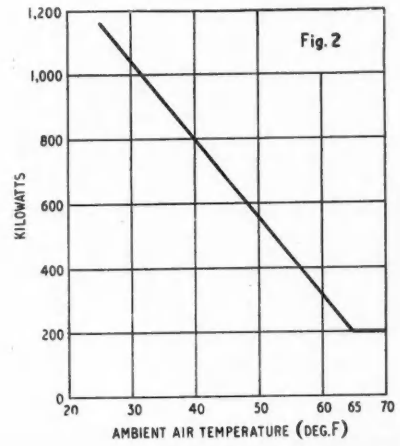
Fig. 1 shows the hourly steam flow at 5 lb/sq in for a factory having a volume of one million cu ft, using 5,000 lb of steam for water and other heating at this pressure, together with the variable space heating steam based on a heat rate of 0·6 B.Th.U/cu ft/hr/deg F.

Fig. 2 shows the kW of electrical energy which could be obtained from this steam quantity if passed through a turbine with an initial pressure of 350 lb/sq in, and temperature 700 deg F. A 1,000 kW extraction turbine would give this steam quantity at 32 deg F ambient temperature and, of course, could give this 1,000 kW of electrical load, even if the ambient temperature rose, say, to 65 deg F, by discharging the excess steam to the condenser.

It should also be noted that with an extraction turbine, one extraction valve should be open at all times to allow sufficient steam to pass through the condensing stages for cooling purposes, otherwise the casing and wheels will become overheated.

Consider now the effect of initial superheat and turbine efficiency ratio. The turbine efficiency ratio is, of course, the ratio: $\frac{\text{actual heat drop}}{\text{adiabatic heat drop}}$. In the case of most straight condensing turbines the exhaust steam is in the wet region, but since in an extraction or pass-out turbine the exhaust must be slightly superheated, the efficiency ratio will probably be lower than for the former. The effect of efficiency ratio and superheat can be seen from





the following examples. In all cases the pass-out pressure is assumed to be 10 lb/sq in with 20 deg superheat. Initial steam pressures considered are 255, 420 and 900 lb/sq in.

(a) Initial steam pressure 255 lb/sq in.

Superheat deg F	100	200	300
Steam temperature deg F	507·8	607·8	707·8
Adiabatic heat drop B.Th.U/lb	169	207	226
Actual heat drop B.Th.U/lb	79	152	205
Turbine efficiency ratio per cent	50·8	73·1	89·3
Steam lb/kWh	35·4	22·5	16·65
kW/10,000 lb steam	282·4	444·4	600·6

(b) Initial steam pressure 420 lb/sq in.

Superheat deg F	100	200	300
Steam temperature deg F	549	649	749
Adiabatic heat drop B.Th.U/lb	227	245	268
Actual heat drop B.Th.U/lb	125	167	219
Turbine efficiency ratio per cent	47·1	67·5	82·1
Steam lb/kWh	32·1	20·7	15·57
kW/10,000 lb steam	311·5	483·1	642·2

(c) Initial steam pressure 900 lb/sq in.

Superheat deg F	100	200	300
Steam temperature deg F	631·4	731·4	881·4
Adiabatic heat drop B.Th.U/lb	289	309	328
Actual heat drop B.Th.U/lb	128	191	245
Turbine efficiency ratio per cent	44·3	61·8	74·6
Steam lb/kWh	29·1	18·6	14·0
kW/10,000 lb steam	345·1	537·3	714·2

From Fig. 3 it will be seen that the following initial steam temperatures will be required to give the requisite terminal conditions for 60 per cent and 75 per cent efficiency ratios. The turbine steam conditions are also stated.

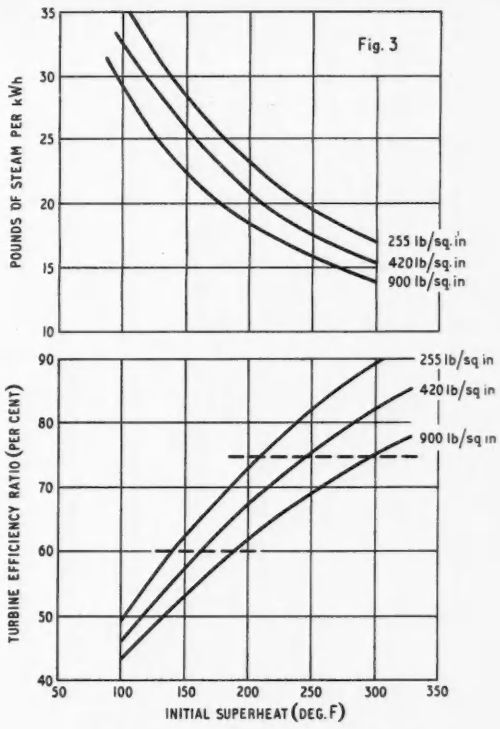
60 per cent efficiency ratio

	Initial pressure		
	255 lb/sq in	420 lb/sq in	900 lb/sq in
Steam temperature deg F	547·8	613·0	718·4
Steam consumption lb/kWh	29·4	24·0	19·4

75 per cent efficiency ratio

	Initial pressure		
	255 lb/sq in	420 lb/sq in	900 lb/sq in
Steam temperature deg F	610·7	691·0	840·4
Steam consumption lb/kWh	22·2	18·0	13·8

The efficiency ratio figure of 60 per cent would be about that expected for a small geared turbine drive, and a figure of 75 per cent would be expected for a larger direct driven turbo set. It will be noted that the steam consumptions quoted are around twice as high as those to be expected from a straight condensing set of similar conditions. In the above figures the no-load steam has not been taken into account. On a small geared turbine, the no-load steam may be as high as 20 per cent of the maximum steam flow, and with a large extraction turbine some 10 to 12 per cent. It is not always realised in employing pass-out or extraction turbines that the coal consumption of the boilers is higher than with straight condensing plant, so the following may help to elucidate the point. In all cases it is assumed that we should



require to generate steam in a boiler, first, direct at 10 lb/sq in, and then at varying higher pressures, using a pass-out or extraction turbine to generate electricity.

The quantity of steam for process by any method would be the same. Let us assume this to be 50,000 lb/hr. Assume also the boiler efficiency to be 80 per cent in all cases, the calorific value being 11,500 B.Th.U/lb in the coal and the feed temperature 180 deg F.

(1) The amount of coal required to generate 50,000 lb steam/hr direct at 10 lb/sq in 20 deg superheat. The heat required to be added to each pound of water would be 1,024 B.Th.U.

The coal required in the boiler would be:—

$$\frac{50{,}000 \times 1{,}024}{0{\cdot}8 \times 11{,}500} = 5{,}367 \text{ lb/hr}$$

For a similar steam quantity per hour, the coal required at the higher pressures would be:—

255 lb/sq in 203 deg superheat = 6,197 lb/hr
420 lb/sq in 242 deg superheat = 6,437 lb/hr
900 lb/sq in 309 deg superheat = 6,697 lb/hr

The coal quantity per hour required in excess of that for direct generation at 10 lb/sq in would be:—

255 lb/sq in = 830 lb/hr
420 lb/sq in = 1,070 lb/hr
900 lb/sq in = 1,330 lb/hr

Our steam quantity entering the turbine is 50,000 lb/hr but if the turbine losses are 12 per cent, then only 44,000 lb/hr is capable of generating electricity.

We found previously that with a 75 per cent turbine efficiency ratio the following steam consumptions per kWh were forthcoming.

Steam pressure lb/sq in	Consumption lb steam/kWh
255	22·2
420	18·0
900	13·8

The kW generated would therefore be:—

$$255 \text{ lb/sq in} = \frac{44{,}000}{22{\cdot}2} = 1{,}982 \text{ kW}$$

$$420 \text{ lb/sq in} = \frac{44{,}000}{13{\cdot}8} = 2{,}445 \text{ kW}$$

$$900 \text{ lb/sq in} = \frac{44{,}000}{18{\cdot}0} = 3{,}186 \text{ kW}$$

The amount of coal required, therefore, to generate 1 kWh would be:—

255 lb/sq in = 830/1,982 = 0·435 lb
420 lb/sq in = 1,070/2,445 = 0·441 lb
900 lb/sq in = 1,330/3,186 = 0·417 lb

It will be seen from this that for these conditions, taking into account the higher capital charges for higher pressure plant, there is little advantage in generating above 255 lb/sq in despite the fact that with pressures higher than this we can obtain a larger quantity of electricity.

If we look at the coal required by the national authority for their electrical generation, we shall see that the thermal efficiency of generation for the whole country is 24 per cent. If the calorific value of the coal used by them averages 10,500 B.Th.U/lb then they will require:—

$$\frac{3{,}412}{0{\cdot}24 \times 10{,}500} = 1{\cdot}35 \text{ lb/kWh}$$

so that for the figures worked out above, we shall only require roughly one-third the coal per kWh as does the national authority.

This is the basis on which lower costs of combined generation rest. To obtain the best results, a high load factor of electrical generation is essential. If we wish to make use of a higher process pressure, say, 100 lb/sq in still with 20 deg superheat, we could assess the merits of generating steam against 420 lb/sq in and 900 lb/sq in.

To obtain an efficiency ratio of 77 per cent at 900 lb/sq in we should require 200 deg superheat at this pressure (i.e. 731 deg temperature) to give us 20 deg superheat in the exhaust. With 420 lb/sq in we should require 130 deg superheat at this pressure to give us an efficiency ratio of 78·5 per cent and 20 deg superheat at the exhaust. Taking the boiler conditions as previously assumed the results would be:—

	420 lb/sq in	900 lb/sq in
Steam per kWh (lb)	35·9	21·5
kW per 100,000 lb steam/hr	2,172	4,093
Coal/hr (lb) over and above that to generate steam	863	1,777
lb coal/kWh	0·392	0·43

This is roughly again one-third of that required by the national authority, and it would appear only necessary to use steam at 420 lb/sq in.

Generating at the higher pressure would, however, allow us to generate twice the electrical energy even though the costs would be somewhat higher. If we can make use of the larger electrical production, instead of having to import from the national authority, it will pay us to do so.

The problem therefore is to assess the electrical energy we can make use of relatively to our process steam requirements.

Power Supply in Victoria

THE State Electricity Commission of Victoria reports that in the financial year ended 30th June, 1956, electricity production rose to a new record figure of 4,429 million kWh —an increase of 459 million kWh over the previous year. Following completion of new plant installations, nine-tenths of the increase in production was met by stations at Yallourn and Kiewa. New consumers connected broke all previous records, home connections averaging 100 a day and farm connections 50 a week. Inclusive of 1,630 consumers formerly served by local country undertakings acquired by the Commission during the year, 29,600 additional consumers were connected. Electricity sales amounted to 3,605 million kWh, an increase of 13 per cent.

"If the Commission is to meet Victoria's rapidly growing electricity needs," says the chairman (Mr. W. H. Connolly), "we must double the capacity of our power system by 1965. For this a capital outlay of £300 million will be required, but if the Commission must continue to rely on present sources of capital, and if the yield from those sources does not improve, we shall be more than £100 million behind Victoria's needs in nine years' time."

The future pattern of electrical development, he says, will be to install at brown coal power stations in the Latrobe Valley new generating units of the largest practicable capacity, to build another large extension at Yallourn power station, and follow this with a new power station of possibly 800 to 1,000 MW at Hazelwood, near Morwell. These plans are dependent upon the Commission's ability to arrange finance. If adequate provision is to be made to meet the State's electricity requirements, capital expenditure should be on a progressively increasing scale, starting with £24 million in the current financial year and rising to over £40 million in 1964-65. On present outlook, however, taking only the next three years, the actual expectation of capital finance is £22¼ million for 1956-57 against the £24 million required to provide properly for the State's needs, £23½ million in 1957-58 against a requirement of £26 million, and £23½ million in 1958-59 against £30 million.

The crucial problem facing the Commission is to ensure finance for the new Yallourn "E" extension. On the present restricted annual budget it is not possible to make any commitment for Yallourn "E" either in the current financial year or in the two following years, though the first of the two generators proposed for that station will be needed not later than 1961. Yallourn "E" will cost £24 million, spread over the next seven financial years, and the Commission is, therefore, inviting offers from firms who are prepared to receive payment by instalments over an extended period, and also from financial interests in Australia and overseas who will lend money to plant contractors to finance the task.

The installed capacity of the State Electricity Commission of Victoria's system now exceeds 1,000 MW. Of the 4,429 million kWh generated last year, more than two-thirds was produced in stations burning brown coal, while approximately 10 per cent was generated in hydro stations. Operating entirely on brown coal, Yallourn power station produced over 40 per cent of all electricity generated in Victoria. Progressive extensions should more than double the station's capacity of 281 MW in the next seven years.

The State system comprises 22 steam, hydro and diesel stations all owned and operated by the Commission except the Melbourne City Council's Spencer Street power station. Eighteen of the power stations, with 98 per cent of the plant capacity, constitute an interconnected system. In addition, the Commission owns and operates four power stations in Mildura and Wimmera which for the present are not connected with the rest of the State system.

Total income last year was £31,101,979 and expenditure £28,989,515, leaving a profit of £2,112,464.

Much of the success of the State's rural electrification programme has been due to strong support given by consumers to the Commission's "self-help" plan for financing high voltage supply extensions by means of advance payments for electricity, and some 20,000 consumers are receiving supply under this plan.

VIEWS on the NEWS

By REFLECTOR

THERE have been several instances of joint meetings being held between various bodies in separate towns in the United States using telephone land lines as the link between the meeting places. Indeed, this sort of thing has also been done by the B.B.C. History was made, however, on Thursday last when a joint meeting was held between the Institution of Electrical Engineers in London, the American Institute of Electrical Engineers in New York, and the Engineering Institute of Canada in Montreal. The three bodies were linked by the new transatlantic telephone cable which, appropriately enough, formed the subject for discussion at the meeting. It was also appropriate that Sir Gordon Radley should be President of the I.E.E. on this occasion for he was closely concerned with both the planning and installation of the cable. The joint meeting lasted just over an hour and went without a single hitch. The consistent high quality of transmission of both speech and music over the cable was most impressive. The British, American and Canadian engineers who have been involved in this project have something to be proud of in successfully completing what is undoubtedly a major achievement in communications engineering. It was forcibly demonstrated at the meeting how small the world is getting as a result of transport and communication developments, since one man who addressed the meeting from Montreal had been in London the previous afternoon.

* * *

Before the third nuclear power station of the Central Electricity Authority is built the name of its site, which it must ultimately bear, should be settled. When the erection of the station was first discussed the proposed position was said to be at Inkley Point, Somerset. Before long the name was being aspirated, becoming Hinkley Point, and a friend who lives in the area assures me that that is what it should be. At the inauguration of the work on the nuclear station at Bradwell, Essex, on 18th January Lord Citrine, chairman of the C.E.A., mentioned Hankley Point in the course of his remarks. That, I believe, is the form which has been used in official notices and so, I suppose, it must be accepted as correct.

* * *

A good many electricity consumers when they receive their quarterly bills swear that they could not possibly have used so much. They blame their meters which, of course, are usually quite in order; generally it is the consumers' memories which are at fault—periods of abnormal use for one reason or another are quite overlooked. There are, of course, cases in which the consumer has good reason for complaint as in a recent instance at Sheffield. A consumer there, with a house and confectionery business on a main road, received a quarterly bill for £32. As this was about three times the normal amount he was naturally perturbed. The meter showed that electricity to this value had been consumed but it continued to run when everything in the premises was switched off. A few months ago a row of 23 sodium lamps had been installed in the road and the consumer had the idea of pulling out his main switch whereupon the street lights were extinguished. Later investigation showed that by some means or other the street lighting cable had been connected to the consumer's service making him an unwitting public benefactor. I am pleased to hear that the Yorkshire Electricity Board is to " adjust " the account.

Commenting on this case, a correspondent to *The Times* says that her last telephone account seemed unduly large. She found that her telephone number (874) had been added in as £8 7s 4d. This recalls the allegedly frequent inclusion of the date among the items in restaurant bills.

* * *

At a recent meeting the West Midlands Gas Consultative Council was told that the Area Gas Board had decided to withdraw its penny-in-the-slot meters because (as can be imagined) they fill up too quickly with gas at the present price. I am surprised to know that there are still 90,000 of these meters in the Board's system and suppose that there must be others elsewhere. The cost of replacement, it is said, will be about £250,000. One never hears of penny-in-the-slot electricity meters now although it is still possible to obtain quite a lot of light, or radio, for a penny. While on this subject, I am indebted to " Contact " (the staff magazine of the Merseyside and North Wales Electricity Board) for the information that frequent blockages in meters were caused by pennies minted in 1912 which were slightly above the normal diameter. " Contact " also says that the thicker-than-usual shillings minted in 1950 also caused trouble in certain types of meter, necessitating the enlargement of the slots.

* * *

Eighty years ago the death occurred of Alexander Bain, a versatile inventor who was responsible for some ingenious electrical devices. In an obituary notice the *Electrical Review* of 1st February, 1877, said that:

> " Bain's first patent was taken out in January, 1841, when he applied currents to clocks. He showed not only how clocks could be worked without any winding, but how any number of clocks could be worked from one standard time-piece, and how uniform Greenwich time could be shown throughout the country. In December of the same year, he showed how electricity could be applied to control railway engines and carriages, by shutting off steam and opening the whistle. At the same time he invented a type-printing machine, and showed how to lay down wires two or three feet underground, in asphalte or pitch, when in a soft state. He also showed how to communicate across rivers and ' bodies of natural water ' without wires, and he in ignorance of Steinheil's work re-discovered the earth circuit. . . . It has been stated or inferred that Bain and his inventions were neglected, and that an unsympathetic Government or world drove him to poverty and decline; but amongst other sums he received, the Electric Telegraph Company paid him £30,000 for his automatic chemical telegraph."

LETTERS TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

"Cooker for a Cripple"

ON page 104 of your issue of 18th January you refer to the cooker illustrated as a new idea. In 1939 the Simplex Company made up specially to my order a "Creda" in exactly the same way. It was considered a great success by the consumer, the extra cost being more than justified.

My aim was to get the oven off the floor to save the housewife having to kneel when using it and to drop the hob to a more sensible and convenient height. In this particular instance the cooker was fitted in the usual recess built for the purpose, supports being placed across and cupboards being made underneath.

I could never understand why the makers made no use of the idea, which after all, was not really new, as it had been used many years ago by makers of petrol air gas (Aerogen & Spencerlite Co.'s) cookers.

Bournemouth. B. W. KELLAWAY
(late Southern Electricity Board).

L.T.E. Power Engineers

YOU will be interested to hear that the ban on overtime and upgrading by these engineers has now been ended. Increases in salary have been offered in several stages and the final offer has been accepted. These salary increases, although not yet up to N.J.B. level, are so high (£100 per annum where £20 was previously offered) that not only is the claim and subsequent action of these supervisors proved justified but also that the originators of earlier parsimonious treatment must stand corrected.

We now hope that a careful survey of conditions of employment will soon take place and a reasonable endeavour made to bring the conditions of these L.T.E. engineers nearer to those negotiated for similar grades in the C.E.A.

Finally, these engineers would add their thanks to mine for the great help given us by the *Electrical Review*.

"ONE OF THEM."

The International Ohm

WHILST appreciating Mr. B. S. T. Wallace's reply in your issue of 4th January to my letter published on 2nd November, it does not answer the questions as I intended them to have been read. To re-word: Why was a non-linear conductor chosen and then having chosen it why was the rating of the current which is to flow not stated?

Although parts of Mr. Wallace's letter deal with the more personal historical facts they are at variance with all the records I have been able to peruse. Admittedly, so far they are only English and American records but each tells a different story in relation to the queries in question. It does appear that this phase of electrical history was never accurately chronicled.

E. J. BEAVEN.

London Board Reorganisation

Completion of Two-Tier Structure

DURING the coming summer and autumn the London Electricity Board will complete its reorganisation programme, begun in 1953, which involves the dissolution of the "three-tier" Sub-Area and District form of organisation. The original seven Sub-Areas and forty-six Districts are being replaced by eighteen "Managed Districts" directly responsible to head office. Four such Managed Districts are already operating successfully, the first having been established in 1953.

Applications for the new managerial posts were invited from the Board's staff. The list below shows appointments (present and designate) which have been made.

The names to be given to the Managed Districts are now under consideration.

The Board has appointed Mr. C. W. Blake, Mr. S. Eclair-Heath, M.I.E.E., Mr. G. J. Moody, M.I.E.E., and Mr. C. G. Moss, Assoc.I.E.E., to headquarters staff as management officers (without departments) to have responsibility for the formation of the new Districts and for the subsequent co-ordination of their activities.

District (Local Authorities' Areas Covered)	Manager	District (Local Authorities' Areas Covered)	Manager
Hampstead and Willesden	Mr. B. L. Wells, B.Sc., M.I.E.E.*	Barnes, Battersea and Wandsworth	Mr. F. A. Geary, M.I.E.E.* (to be succeeded on his retirement by Mr. H. Lloyd-Williams, D.S.O., V.R.D., B.Sc.(Eng.), M.I.E.E., A.M.I.C.E.)
Hammersmith and Fulham	Mr. J. Brocklebank, M.I.E.E.		
Chelsea, Kensington and Paddington	Mr. W. Millner, B.Sc., M.I.E.E.		
St. Pancras and St. Marylebone	Mr. J. J. Lesser* (to be succeeded on his retirement by Mr. R. C. Tuffnell, M.I.E.E.)	Malden and Coombe, Merton and Morden, Mitcham and Wimbledon	Mr. A. B. Catling, A.M.I.C.E., A.M.I.E.E. (to succeed Mr. W. J. Sageman, A.M.I.E.E.* on his transfer to Westminster)
Holborn and Westminster	Mr. W. J. Sageman, A.M.I.E.E. (at present manager at Wimbledon)		
Hackney, Islington and Stoke Newington	Mr. R. H. Rawll, M.I.E.E., M.I.Mech.E.	Camberwell and Lambeth	Mr. G. M. T. Wilson
City, Finsbury and Shoreditch	Mr. G. H. Fowler, M.I.E.E.	Bermondsey, Deptford and Southwark	Mr. T. R. Starr, A.M.I.E.E.
Bethnal Green, Poplar and Stepney	Mr. R. C. R. Brooke, A.M.I.E.E.	Beckenham, Bromley, Lewisham and Penge	Mr. L. A. Gripper, M.I.E.E. (to be succeeded on his retirement by Mr. D. E. Gough, B.Sc.(Eng.), M.I.E.E.)
Walthamstow and Leyton	Mr. R. Thompstone, Associate I.E.E.		
Chigwell (part), Dagenham (part), Ilford, Wanstead and Woodford	Mr. J. R. Kinnersley, M.I.E.E.	Greenwich and Woolwich	Mr. F. N. Sherborne, A.M.I.E.E.
Barking, East Ham and West Ham	Mr. A. E. Morgan, B.Sc.Tech., M.I.E.E., A.M.I.Mech.E.	Bexley, Crayford, Dartford, Erith, Chislehurst and Sidcup (part)	Mr. R. Bell, A.M.C.T., M.I.E.E., A.M.I.Mech.E.

* Existing appointment.

PARLIAMENTARY REPORT

Future Legislation

IN the House of Commons Mr. Macmillan, the Prime Minister, informed Mr. Arthur Lewis that the new Government hoped to go forward with the whole of the legislative programme announced by the Eden Government.

Mr. Kaberry asked which Minister would answer questions in the House relating to atomic energy and other research matters within the responsibility of the Lord President of the Council (Lord Salisbury).

Mr. Macmillan said that this would be done by the Paymaster-General (Mr. Reginald Maudling).

Factory Inspectorate

Mr. Iain Macleod, Minister of Labour, informed Mr. Willey that action was being taken on the Report on Staffing and Organisation of the Factory Inspectorate. Some additional staff had already been recruited and others would shortly be interviewed. The boundaries of the inspectorate were being adjusted to avoid overlapping with the normal Government regional boundaries and a new division had been established, with headquarters at Newcastle-on-Tyne.

National Service Deferment

Mr. Macleod gave a list of men whose National Service call-up had been deferred. This included 170,200 apprentices, 32,300 articled pupils, 2,800 scientific research workers on high priority work, 191 teachers with first or second class honours degrees in science and mathematics, 6,200 boys studying for the G.C.E. or other external examination, and 50,600 students following full-time courses of further education. He pointed out that men with first class honours degrees in science or engineering who completed their course of study or training in 1957 and took up employment in this country would be deferred in 1957.

Fuel Shortage

When questions were asked about the effect of the shortage of petrol and oil on employment, Mr. Lee said that there was great anxiety throughout the country because there was a feeling that the Government were losing control of the situation. Following the statement of the Minister of Power, there was great apprehension whether the Government could maintain some of our vital industries in full production. Was there to be any priority allocation of fuel oil to allow industries such as the steel industry to maintain their production and thus help the manufacturing industries?

Mr. Macleod said the main anxiety for the future was the question of fuel oil for industry. If stocks could be maintained at the present level—and that depended on many factors not under the control of the Government—he did not think the position should worsen appreciably.

Railway Modernisation Contracts

In a committee debate on the Transport (Railway Finances) Bill, Mr. Ernest Davies said it was gratifying to note that a large number of contracts for electrification and for other parts of the railway modernisation programme had already been placed, but the Minister should give an assurance that the programme was up to schedule and that the £90 million which was to have been spent in 1956 had been forthcoming.

Mr. Harold Watkinson, the Minister of Transport, said that the success of the modernisation plan depended on team work on the railways and he thought the new productivity schemes would help. But if the men in the railway industry did not want the plan to work then the plan was finished; the railways would have to be broken up and disposed of.

Electronic Computers at the N.P.L.

Mr. Willey asked the Government how many staff at the National Physical Laboratory were employed on the application of electronic computers to clerical and administrative work. Mr. Harmar Nicholls, Parliamentary Secretary, Ministry of Works, replied that two were employed full-time, with one other giving part-time supervision.

Atomic Power Programme

Mr. Gower asked the Paymaster General if he would arrange for the allocation to Wales of part of the enlarged atomic power programme recently approved by him.

Mr. Maudling said the siting of power stations in England and Wales was primarily a matter for the Central Electricity Authority and must chiefly depend on the availability of suitable sites and the pattern of demand for electricity. He was sure the Authority would give every consideration to possible sites for nuclear stations in Wales. No revised nuclear power programme had yet been approved.

Electricity Employees' Pensions

Mr. Elwyn Jones asked when the increases in payment of pensions to pensioners of former local authority electricity undertakings were to begin.

Mr. Maudling said the Minister of Power was giving careful consideration to the Central Electricity Authority's proposals and would give his decision as soon as possible.

Supply to Holy Island

Mr. Frederick Willey asked the Paymaster-General whether he would make a statement on the inquiry regarding the supply of electricity to Holy Island.

Mr. Maudling said the Minister of Power was still in consultation with the Minister of Housing and Local Government about this case but hoped to reach a decision shortly.

Volta River Scheme

Mr. Wilfred Paling asked the Secretary of State for the Colonies if the Government had yet reached any decision, in principle, to participate in the Volta River project, in view of the still rising costs of material and equipment.

Mr. J. Profumo, Under-Secretary, replied that the position remained as stated by the Colonial Secretary on 26th July last.

Unemployed in the Radio and Lamp Industries

Mr. Hunter was informed by Mr. Macleod, Minister of Labour, that at 10th December last there were 1,028 unemployed in the radio apparatus and gramophone industry, and 312 unemployed in the radio valves and electric lamps industry.

Electricity Bill

The consideration of the Electricity Bill in committee, which has twice been postponed, is now due to begin on 5th February. The committee is likely to sit on Tuesday and Thursday mornings. So far only about twenty amendments have been put down, twelve of them by the Government and relating to minor drafting points.

Prices of Materials

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM ingots	ton £197 0s 0d
COPPER, H.C. Electro	ton £261 0s 0d
Fire Refined 99·7%	ton £260 0s 0d
Fire Refined 99·50%	ton £259 0s 0d
COPPER Tubes ..	lb 2s 6½d
Sheet	ton —
H.C. wire and strip ..	ton £312 15s 0d
LEAD, English ..	ton £114 15s 0d
Foreign	ton £113 0s 0d
MERCURY	flask £84 15s 0d
TIN, block (English) ..	ton £797 0s 0d
ZINC, G.O.B. Foreign	ton £104 0s 0d
Electrolytic	ton —
BRASS Tubes (solid drawn)	lb 2s 1½d
Sheet	ton —
Wire	lb 2s 9½d
PHOSPHOR BRONZE Wire	lb 4s 2½d
PLATINUM	oz £34 0s 0d
RUBBER, No. 1 R.S.S. spot	lb 27½d—27¾d

Customs Duties Bill

MOVING the second reading of the Customs Duties (Dumping and Subsidies) Bill in the House of Commons last week, Sir David Eccles, President of the Board of Trade, said it would give the Board power to impose a duty on goods dumped in Britain or sent to Britain with the artificial aid of subsidies. Duty would only be imposed when it could be shown that the entry of the goods would injure established sources of supply. The Bill was introduced not to protect the British market against competition from legitimate low-cost production but was aimed solely at unfair trade practices. The United Kingdom could not move further towards free trade unless it was certain that the trade would be fair. This applied particularly to the proposed European free trade area. British industry expected to be challenged by the products of European manufacturers but, providing the competition was fair, industry was confident of winning a rich reward in the markets across the Channel.

In the Bill the Board of Trade was given discretion, in the last resort, to define what was a fair price. The powers were permissive since the duty was to be imposed only when it was in the national interest. Most Commonwealth countries, the United States and many other foreign countries already had similar powers and used them. If the Bill was really successful the Government would not have to use the powers. The deterrent should be sufficient.

Definition of "Dumping"

Mr. Gordon Walker said that dumping was easier to recognise than to define. It was a fact that many of the world's exports—including many of ours—were exported at a cheaper price than prevailed at home. The sound economic reason for that was that exports in the main were marginal additions to the production for the home market. This was a widespread and economically justifiable practice, yet under this Bill it was "dumping." The definition did not meet what everyone meant by genuine dumping—unloading surplus stocks at throw-away prices or subsidies designed to export unemployment from the country concerned.

The wide powers under the Bill were dangerous because they would render the Board of Trade subject to pressures from all sorts of vested and special interests. The President of the Board of Trade could keep out low cost imports even if they were not dumping. Fears had been aroused that the rigours of competition would be softened by smuggling in protection dressed up as anti-dumping. We could not enter into the free trade area with all sorts of restrictions and special powers and provisions.

Mr. Richard Fort said the Bill would give confidence to those who had legitimate fears and worries about the future of trade as the European free trade policy was introduced.

Sir John Barlow said it appeared from the Bill that the initiative would have to be taken by a manufacturer or trade association and the Board of Trade would have to see if there was a *prima facie* case for action. It would seem that the manufacturers or associations would be put to much trouble and expense to provide the information, and more should be said about how the provisions of the Bill would work. Dumping could have devastating effects on British industry and Britain was one of the most sought-after markets in the world, so it was important to have protection.

Mr. Ernest Thornton thought too much of our resources had been concentrated upon capital goods and equipment, in the production of which Russia would probably beat the rest of the world in the next decade. Therefore our consumer goods and light industries should not be neglected.

Rejection of Bill Moved

Mr. Arthur Holt, Liberal Member for West Bolton, as a free trader, moved the rejection of the Bill. He said that if it was really intended that there should be a European free trade area the Bill would be quite unnecessary. We were "dumping" all over the place, within the context of the provisions of the Bill. He mentioned a Press conference with representatives of the electrical manufacturers on 18th October. The Monopolies Commission had looked into their sales arrangements because it was suggested that they were selling generators, etc., to the Central Electricity Authority on equal tendering. At the conference it was stated that the electrical industry was the second largest exporting industry in Britain and had been subjected to the most acute competition. It had met with considerable success but it was made clear that this had only been possible because British manufacturers had been able to make good at home the losses they had incurred abroad.

Mr. Gerald Nabarro said that Mr. Holt was presenting only half the story. If one followed this argument through to its logical conclusion one would assume that the entire output of the electrical manufacturers was sold to the monopoly of the C.E.A. and that losses abroad were being recouped by charging the nationalised undertaking an unduly high price. That was quite wrong. Heavy electrical manufacturers sold a very large part of their output on the home market to private enterprise undertakings and not only to the C.E.A.

Capt. Duncan asked why some of these foreign countries, which had the powers which the Government now sought to obtain in the Bill, had not taken action if this was the case.

Mr. Holt said that possibly they would do so in the future. His point about the electrical manufacturers was made to give one instance of technical dumping on our part. Were we to impose anti-dumping duties upon some electrical manufacturers from abroad who had admitted in the Press that they were getting a higher price in Germany than in Britain, and were not making a profit in Britain? Such action might only be marginal but technically it was still dumping.

Mr. Gerald Nabarro, who gave his full support to the Bill, said there would often be price differentials between goods of the same kind sold on the home market and those exported. He shuddered to think what the finances of the National Coal Board would be like now if there had not been a substantial premium or price advantage on coal sold in Western Europe and elsewhere since nationalisation.

European Common Market

Mr. R. Gresham Cooke said that two-thirds of British industry, through the Federation of British Industries, had expressed agreement with the European common market, but it could not work unless the conditions and tariffs were fair on all sides. He was doubtful whether the Bill would be effective in ensuring this, because in deciding whether the price of imported goods was fair the Bill insisted that the comparison should be made between the wholesale price at which goods were brought into this country with the retail price of the goods in the foreign country. If this was so the Bill would be brought into disrepute at once. Even if he was wrong in this interpretation the Clauses should be looked at again to see if they were watertight.

Mr. Walker-Smith, Minister of State, Board of Trade, said that ordinarily, action would be initiated by the Board of Trade as a result of representations from aggrieved industries or companies. If evidence was submitted and the Board found there was a *prima facie* case for action, there would be some procedure for advertising the application with a view to giving other interested parties the right of objection before the Board of Trade made up its mind whether there was a case for making an Order. Then the Board would have the duty of making a decision in the broad national interest. Clause 6 defined the export price as the f.o.b. price which, in the Government's view, was the true yardstick of comparability with the overseas domestic price. Clause 7 provided that adjustments could be made to allow for differences in manufacturing conditions, terms of sale and taxation, so that there would be a proper, effective comparison of like with like.

The motion to reject the Bill was negatived and the Bill was given a second reading.

PERSONAL AND SOCIAL

News of Men and Women of the Industry

Sir Percy Mills, Bt., who was raised to the peerage upon his appointment as Minister of Power, has taken the title of Baron Mills of Studley, in the county of Warwick.

The Metropolitan-Vickers Electrical Export Co., Ltd., announces that **Mr. H. F. Bibby,** B.Sc.Tech., A.M.I.E.E., A.M.I.Mech.E., assistant general manager, and **Mr. G. H. Jolley,** M.I.Mech.E., principal representative of the Export Co. at Trafford Park, have been appointed to the board.

Mr. Bibby joined the Metropolitan-Vickers Electrical Co. in 1929 for the first year of a probationary college apprenticeship course, returning to complete the course four years later and then joining the staff of the Motor Engineering Department. In 1939 he transferred to the M-V Export Co. and went to The Hague as liaison engineer with the company's former agents in Holland, from which country he escaped to England with his wife three days after the German invasion of May, 1940. During the war he was engaged on development work in the Motor Engineering Department. In 1945 Mr. Bibby rejoined the Export Co. and in the following year returned to Holland as manager of the company's new office at The Hague. During 1951 he spent several months in South America and he was subsequently appointed manager, American Division, of the Export Co. in London. He was appointed assistant general manager in August last.

Mr. H. F. Bibby

Mr. G. H. Jolley

Mr. Jolley first joined M-V as a vacation apprentice in 1919. After technical education at the Manchester College of Technology followed by a college apprenticeship at Trafford Park, he joined the company's Erection Department, first as a special trainee and later as erection engineer in which capacity his duties took him to Russia, South America, Egypt, Belgium, Roumania and South Africa; from 1934 to 1939 he was in China and Japan as resident engineer. From 1940 to 1945 Mr. Jolley was assistant works engineer at the Trafford Park Works. From 1946 he represented the M-V Export Co. in Malaya and the Far East. Returning to this country in 1951 he was appointed assistant chief engineer, Energy Application Engineering Department. In November, 1954, he rejoined the M-V Export Co. as principal representative at Trafford Park. He is a former chairman of the M-V Overseas Association, and has been a vice-president since 1953.

On his appointment as Parliamentary Under-Secretary of State for Air, **Mr. C. I. Orr-Ewing,** M.I.E.E., has resigned his directorships of A. C. Cossor, Ltd., Cossor Radar & Electronics, Ltd., and Cossor Communications, Ltd.

Sir Hugh Beaver, having become deputy president of the Federation of British Industries, has been obliged to limit his other activities and has resigned from the Council for Scientific and Industrial Research.

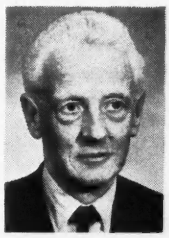
Mr. C. H. Fielding, B.Sc.Tech., A.M.I.Mech.E., who writes in this issue on "Combined Generation" (page 188), was awarded a Lancashire County Council technological scholarship as a result of which he took a degree course at Manchester College of Technology in mechanical engineering. Subsequently he served with the electricity undertakings at Manchester, Oldham and Halifax before becoming power station superintendent with the Singer Manufacturing Co. at Clydebank.

Mr. D. A. Pitman has been appointed to the board of Electronic Instruments, Ltd. Mr. Pitman received his early training with Ekco, Ltd., and subsequently with Marconi Instruments, Ltd., where, for fourteen years, he was concerned with many phases of the company's activities. In 1950 he set up and managed its New York sales office. He returned to England five years later and was appointed to a senior sales position with the English Electric Co., Ltd. He joined Electronic Instruments in 1956 as commercial manager, and in his new appointment as sales director will be responsible for co-ordinating all the selling activities of the E.I.L. companies at home and overseas.

Electroway Heaters, Ltd., has announced the following appointments to its board:—**Messrs. C. E. Bream,** F.C.A., **A. Finlayson, W. F. Jordan** and **K. M. T. Young.**

Mr. Wilfred Merchant, M.A., D.Sc., who has been appointed to the newly-created Chair in Structural Engineering in the Faculty of Technology of the University of Manchester and the Manchester College of Science and Technology, was with the Metropolitan-Vickers Electrical Co., Ltd., during the war. He was in the Gas Turbine Department engaged in development work in connection with jet engines for the Ministry of Aircraft Production.

Mr. P. M. Wilson, M.I.E.E., has been appointed chief engineer of the South Western Electricity Board in succession to Mr. G. O. McLean, who recently resigned to become an engineering and industrial consultant. Mr. Wilson, who has been deputy manager of the Board's Bristol Sub-Area since 1951, has served in the electricity supply industry for thirty-four years. He was educated at Edinburgh University and Heriot-Watt College, Edinburgh, and joined the Edinburgh Corporation Electricity Department in 1922, going to Bristol in 1925 to join the Corporation's electricity undertaking. After serving in various departments he became mains engineer in the city and when the Board took over in 1948 he was appointed distribution engineer (planning) for the whole of the South Western area, later becoming deputy chief engineer. Mr. Wilson has served on a number of national technical committees relating to electricity supply and has also played a prominent part in building up the Board's civil defence organisation throughout the South West.



Mr. P. M. Wilson

Mr. B. Wilkinson, formerly managing director of Electronic Tubes, Ltd., has joined the Plessey Co., Ltd., as divisional manager of the Swindon Components Division. Mr. Wilkinson has considerable experience in industrial management, both in Australia and the United Kingdom. Graduating as a bachelor of electrical and mechanical engineering from Sydney University in 1929, he joined the Engineering Department of Amalgamated Wireless (Australia), Ltd. Mr. Wilkinson subsequently became manager of that

Mr. B. Wilkinson

company's Marine Engineering Department and, acting for J. & E. Hall, Ltd., was responsible for marine refrigeration servicing for ships of the U.S. Navy, Royal Australian Navy, Royal Navy, Allied Fleets and Mercantile Marine in Australian waters. In 1945 he became responsible for installation and servicing the company's refrigerating and air conditioning equipment in both land and marine markets. He resigned from Amalgamated Wireless (Australia), Ltd., in 1946, and came to England to take up an appointment as commercial manager (later commercial director) of E.M.I. Factories, Ltd. In 1949 he was appointed director of Electronic Tubes, Ltd., an associated company of E.M.I., and two years later was appointed managing director.

Sir Arthur Whitaker, K.C.B., M.Eng., M.I.C.E., has been elected president of the Institution of Civil Engineers in succession to the late **Mr. H. J. F. Gourley,** whose death we recently reported.

Mr. B. J. Wall, A.C.I.S., assistant secretarial officer in the Northmet Sub-Area, Eastern Electricity Board, since vesting day, has been appointed secretarial officer of that Sub-Area as from 1st February, following the retirement of Mr. E. J. Jones. Mr. Wall joined the North Metropolitan Electric Power Supply Co. at Wembley in 1922 and in 1924 he was appointed to a post in the secretary's office, subsequently becoming a secretarial assistant.

Mr. B. J. Wall

Mr. H. G. Sturgeon has resigned from the board of Ultra Electric (Holdings), Ltd., and its subsidiary, Ultra Electric, Ltd. Mr. Sturgeon has been a full-time executive director of the subsidiary, and he is leaving by mutual arrangement.

Mr. G. S. Nott, managing director of the Lee Beesley group, has been elected to the board of Veritys, Ltd., and has been appointed chairman.

The new wages claim now before the electrical industry brought comment from Mr. L. C. Penwill, director and secretary of the **Electrical Contractors' Association,** when speaking at the fifth annual dinner and ball of the Croydon Branch of the Electrical Contractors' Association on 22nd January. Mr. Penwill, in urging the need for a period of wages stability, said that only by a reasonable period of stability in wages and the cost of living and through increased production could the cost of the pound be raised and its purchasing capacity secured. Mr. S. L. Barlow, past-president, also spoke and in proposing the health of the Association and of the Croydon Branch in particular, the borough engineer, Mr. A. F. Holt, thanked the contractors for assistance on many local projects including schools and housing and asked for their help in trying to keep down the high cost of houses. The 232 guests who attended the function, and who included the Mayor and Mayoress of Croydon (Ald. and Mrs. D. G. Stewart), were welcomed by the branch chairman, Mr. W. A. Buxton, and Mrs. Buxton.

The Electrical Association for Women has announced that the 1956 winner of the Elizabeth Sloan Chesser Cup is **Mrs. B. J. Cawood,** London Electricity Board, Walthamstow. The runner-up is **Mrs. J. Hallworth,** North Western Electricity Board, Stockport, Cheshire.

The annual award for the school whose students gained the best average marks in the E.A.W. Home Workers' Examination for Schools goes to the Mark Hall County Technical Modern School, Harlow New Town, Essex, and last year's holders, the Dame Allan's Girls' School, Newcastle-upon-Tyne, are the runners-up.

The Cheltenham Branch of the E.A.W. offers prizes of £5, £3 and £2 to the housewives gaining the highest marks in the Home Workers' Examination, the money to be used to buy some piece of electrical equipment. The first and third prizes are awarded to **Mrs. Ena M. Minton** and **Mrs. Ruth Holmes** (Loughborough Branch) and the second prize to **Miss Helen M. Clark** (Edinburgh Branch).

Rear-Admiral W. H. Selby, C.B., D.S.C., has been appointed resident representative in Helsinki of the Federation of British Industries and its subsidiary company British Overseas Fairs, Ltd., for the British Trade Fair and Exhibition to be held there in September.

Mr. L. F. Matthews, formerly of the Ekco Car Radio Sales Division, has been appointed sales manager of the Egen Electric, Ltd.

Mr. John E. Collins has recently joined Courtney, Pope (Electrical), Ltd., as a lighting engineer. Mr. Collins, who has sat on various lighting committees, is an associate member of the Institution of Engineering Designers and a member of the Illuminating Engineering Society.

We are informed that due to petrol rationing, the Berks, Bucks and Oxon Branch of the **Electrical Industries' Benevolent Association** has decided not to hold its annual ball on 15th March at the Olympia Ballroom, Reading.

At the company's head office in Hatton Garden recently Sir John Dalton, chairman of **W. T. Henley's Telegraph Works Co., Ltd.,** presented awards for long service to members of the staff. At a similar ceremony at Henley's North Woolwich Works on 21st January, Sir John presented sixteen employees with momentoes of their long service.

A further presentation by Sir John took place at the Gravesend Works on Wednesday this week, when twenty-nine employees received awards.

Mr. W. Jervis, district commercial engineer, Wembley, resigned from the Eastern Electricity Board's service on 31st January. He joined the North Metropolitan Electric Power Supply Co. as assistant sales engineer at Tottenham in 1925, becoming sales engineer in 1928. In 1934 he was appointed sales engineer at Wembley, and in 1939 took up a similar position at Hendon. He returned to Wembley in 1945, becoming district commercial engineer after vesting date.

Mr. W. Jervis

The annual dinner of the **Electrical Wholesalers' Federation** will be held on 21st March (6.30 for 7 p.m.), at the Dorchester Hotel, London, W.1.

The Cleethorpes Branch of the **Electrical Association for Women** celebrated its 21st birthday on 10th December last at a special dinner, when the Mayor and Mayoress, Councillor and Mrs. C. Edwards, were present.

The Sevenoaks Branch also celebrated its 21st birthday on 23rd January, when the chief speaker was Miss A. S. Lockhart, E.A.W. headquarters; Mrs. Eve, branch chairman, presided.

Permanoid, Ltd., has appointed **Mr. L. H. Coley** as its southern area sales manager, operating from its London office. Mr. Coley has had many years' experience in the cable industry with Derby Cables, Ltd., and Crompton Parkinson, Ltd. He will be responsible for the sale of all the products of Permanoid, Ltd., in the South of England.

Mr. L. H. Coley

OBITUARY

Mr. S. Gough.—The death occurred on 4th January at the age of fifty-seven of Mr. Stanley Gough, district engineer, District 348 (Cardiff West) of the South Wales Electricity Board. Mr. Gough was on the outside mains staff of the Cardiff Corporation Electricity Department when the under-

taking was taken over by the Board. He was a member of the Cardiff City Council, and had been active in the affairs of the Electrical Power Engineers' Association of which he was president in 1944. He was national treasurer of the Association at the time of his death.

Mr. J. G. Bland, A.M.I.E.E., manager of the Bletchley district of the East Midlands Electricity Board, died suddenly on 28th January at the age of fifty-four. After serving his apprenticeship with Veritys, Ltd., Mr. Bland joined the Northampton Electric Light & Power Co., Ltd., in 1924, becoming district engineer at Daventry and Wolverton before being appointed district manager at Bletchley in 1950.

Mr. R. A. Weaver.—The death occurred on 26th January at the age of eighty-two of Mr. Richard Albert Weaver, O.B.E., M.I.E.E., who was formerly with the Post Office Engineering Department.

Dame Caroline Haslett. — The church of St. Martin-in-the-Fields, London, was completely filled by those who attended the memorial service to Dame Caroline Haslett last Friday. In addition to relatives and a great number of officers and members of the Electrical Association for Women, there were present leaders of all branches of the electrical industry and profession. There were also many representatives from other spheres of Dame Caroline's varied interests.

The service was conducted by the vicar, the Rev. Austen Williams, M.A. Miss Norah Balls, J.P., chairman of the National Executive Committee of the E.A.W., read the lesson and Lord Citrine, chairman of the Central Electricity Authority, gave the address. Lord Citrine spoke in glowing terms of Dame Caroline's many qualities and expressed the general feeling that by her death the electrical world, and the country, had lost a valuable servant.

WILLS

Mr. F. Soddy, M.A., LL.D., F.R.S., one of the pioneers of research into atomic disintegration, who died on 22nd September last, left £36,725 gross (£36,477 net).

Mr. A. B. Gilbert, M.I.E.E., who had served with the Post Office Engineering Department for many years at Nottingham and Edinburgh, and who died on 16th July, left £14,197 gross (£14,158 net).

Mr. A. D. Markland, assistant manager of the British Thomson-Houston Co.'s Turbine Sales Department, until his retirement in 1946, who died on 5th October, left £6,143 gross (£6,050 net).

Mr. R. B. Burrowes, B.Sc., M.I.E.E., former head of the Electrical Engineering Department of the Liverpool City Technical School, who died on 1st October, left £15,232 gross (£14,995 net).

Mr. J. V. Franklin, managing director of Black & Decker, Ltd., who died on 7th October last, left £20,335 gross (£18,755 net).

Mr. G. N. Fox, non-ferrous development manager of the Spencer Wire Co., Ltd., Wakefield, previously a director and general manager of the Concordia Electric Wire & Cable Co., Ltd., who died on 18th October last, intestate, left £15,598 gross (£1,192 net).

Greek Electrical Trade

A report by Mr. F. C. Mason, Counsellor (Commercial) at H.M. Embassy, Athens, on the economic and commercial conditions in Greece (H.M. Stationery Office, 4s 6d net), states that although imports from the United Kingdom had fallen to just under 10 per cent of Greece's imports by 1952, there has been a steady increase since that time which has more than kept pace with the increase in Greek imports as a whole since devaluation. British machinery of all kinds continues to be in great demand, the value of electrical machinery, apparatus and appliances imported, f.o.b., totalling £1·3 million in 1955, of which telegraphic, telephone and radar equipment accounted for £140,000, insulated electric cables and wires, etc., for well over £600,000, and transformers, motors, batteries and meters for the bulk of the rest. There are three concerns in Greece producing electric motors and generators up to 120 h.p., and five factories make domestic electrical appliances such as cookers, heaters, water heaters, refrigerators and lamps.

Mr. Mason deals with electrical power development under the programme of the United States Economic Mission. It was estimated at the time of the report (June, 1956) that the capacity of stations of the Public Power Corporation (established in 1950) would be 345,000 kW by the end of the year 1955-56, and would total 701,500 kW by 1963-64. In May last year the Greek Government announced its intention to nationalise all electricity supply undertakings.

Indian Market for Electro-Medical Apparatus

In a report prepared for the Board of Trade on the market for electro-medical apparatus in India, the United Kingdom Trade Commissioner Service in India states that the Government of India is pursuing a policy of improving hospital and medical facilities as part of its Five Year Plans. There is therefore a consistently expanding demand for X-ray and electro-medical apparatus which can only in part be met by local production. In the year 1951-52 the United Kingdom held the position of main supplier of these products, sending goods to the value of Rs.12,42,123, representing 34 per cent of the total value of imports in that year. This performance, however, marked the peak and United Kingdom manufacturers have since progressively lost ground, first to the United States and more recently to other European countries, particularly Holland and Western Germany. In addition to losing their share of the expanding market, there has been a decline in the value of United Kingdom exports which last year dropped to Rs.8,67,122, or about 17 per cent of the import total.

The greater proportion of the demand is for X-ray equipment, with a declining demand for infra-red and ultra-violet lamps and a small demand for cardiographs, diathermy machines, radio encephalographs, stimulators and idiometers. The reasons for this failure to keep step with rising demand are attributed to uncompetitive prices, slower deliveries, less credit facilities and also the restricted range of apparatus on offer, though it is admittedly of high technical quality.

According to a leading Indian authority India requires a sturdy, simple piece of equipment which will work efficiently and be sold at a low price, not highly technical and complicated instruments at prohibitive prices. The local assembly and manufacture of X-ray equipment by foreign firms in India is expected to increase in the near future and will provide further difficulties to United Kingdom exporting manufacturers who, if interested in the long-term market in India, are advised to consider the submission of "manufacturing" schemes to the Government of India at an early date.

Bathroom Fatalities

An electric kettle which fell into the bath was stated at an inquest at Guildford last week to have caused the death of a 25-year-old medical student, Miss Ann Stephenson. Her father said the kettle was installed to provide shaving water for his son. Dr. D. Haler said that "all too many" deaths were caused by electrical appliances in bathrooms. Recording a verdict of "Accidental death," the coroner said that Mr. Stephenson was in no way to blame.

At an inquest at Manchester on Miss Jean Elizabeth Burns, aged 31, it was stated that a lamp with a long flex was connected to a switch in a bedroom and used in the bathroom where there was no electric light. Told by the coroner that it was a most dangerous system, her brother-in-law, Mr. E. Jubb, said it had been fitted by an electrician. The coroner expressed the view that Miss Burns was probably drying herself after a bath when she knocked the lamp into the bath. The room would have been in darkness and she had picked up the lamp, getting hold of the metal end. She received severe burns and died from electric shock. Recording a verdict of "Death by misadventure" the coroner added that the public should take warning from this case.

INDUSTRIAL NEWS

Electric Lamp Industry Council

A new body, the Electric Lamp Industry Council, is being formed by a number of British companies whose products conform to British Standards. The objects are to maintain high standards of quality, to encourage fair trading and to promote, develop and safeguard the interests of all who make, buy, sell or use electric lamps in the United Kingdom. The new Council will have no jurisdiction in respect of list prices which will be determined by manufacturers individually.

In addition to providing facilities for consultation between its member firms the Council will represent the electric lamp industry in negotiations with Government and other official bodies. The founder members include Aurora Lamps, Ltd., the A.E.I. Lamp & Lighting Co., Ltd. ("Ediswan," "Mazda" and "Metrovick"), British Electric Lamps, Ltd. ("Bell"), Crompton Parkinson, Ltd. ("Crompton" and "Kye"), Cryselco, Ltd., Ekco-Ensign Electric, Ltd., the General Electric Co., Ltd. ("Osram"), Philips Electrical, Ltd., Pope's Electric Lamp Co., Ltd. ("Elasta"), Siemens Bros. & Co., Ltd. ("Siemens" and "Sieray"), the Stella Lamp Co., Ltd., and Thorn Electrical Industries, Ltd. ("Atlas").

The Council will begin operations in March next and its first chairman will be Mr. J. G. Christopher (Thorn Electrical Industries, Ltd.). The secretary is Mr. E. J. Counter, Newnham House, 13, Bloomsbury Square, London, W.C.1 (Chancery 6462).

Hungarian Students' Fund

A special scholarship fund for Hungarian electrical engineering students has been announced by Sir Gordon Radley, President of the Institution of Electrical Engineers. The fund will be applied to help student refugees from Hungary to complete their engineering education and contributions should be sent to the hon. secretary, Scholarship Fund for Hungarian Electrical Engineering Students, c/o the Institution of Electrical Engineers, Savoy Place, London, W.C.2.

Sales of Lighting Fittings

Because of substantial changes in marketing conditions for street lighting lanterns, the Electric Light Fittings Association says that the text of Schedule 3, Category 3, as appearing in the sixth edition of the Fair Trading Policy, can no longer be applied. The present text is, therefore, being replaced by wording stating that where street lighting lanterns (and parts) specifically designed for the lighting of streets or roads are sold for the lighting of publicly-owned streets or roads, or other streets normally open for the unrestricted use of the public (except on private or nationalised industrial premises), no list prices or discounts shall obtain, net prices always being adopted.

Where these lanterns or parts are sold for any other purpose than the foregoing, prices shall be at the manufacturer's discretion, having due regard to the relative status of the different categories of buyer.

G.E.C. Export Guide

The second issue of the "Export Guide" issued by the General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2, is now available. These very elaborate charts show diagrammatically the principal factors in the production and overseas trade of the world's principal countries, activity in thirty-six main product groups, and trends in production and trade, with particular reference to prospects for British exports.

The charts are accompanied by an adequate amount of explanatory text. It is deduced from the market studies upon which the guide is based that the outlook for British exporters has brightened since last October by reason of the improvement in the national economies of several countries. There are however certain exceptions to this general rule.

Portuguese Radio-Telephone Link

The Automatic Telephone & Electric Co., Ltd., have been awarded a contract for the supply and engineering of a complete u.h.f. frequency modulated wide-band radio-telephone link in Portugal, by the Anglo-Portuguese Telephone Co., Ltd., through Telephone & Associated Services, Ltd.

The radio equipment, which is being supplied and installed by Marconi's Wireless Telegraph Co., Ltd., consists of two Marconi Type HM.200 multi-channel equipments and aerials. It is of particular interest in that it makes use of three new travelling-wave tubes for the amplification of the ultra high frequencies employed, and thus represents a new departure in u.h.f. point-to-point communication. The installation, which will span the River Tagus from Lisbon on the northern bank to the rapidly expanding industrial area of Montijo in the south—a distance of some 14 km—will cater initially for 60 high grade radio-telephone channels and ultimately it will provide 240 circuits.

A radio system was chosen in preference to submarine cable because of the difficulties of cable laying, in that about 50 kilometres of cable, including a section of submarine cable across the River Tagus, would have been required to provide the same service as the fully automatic radio system. A.T. & E. carrier equipment will be installed by the Anglo-Portuguese Telephone Company at the two terminal points—Graca, an automatic exchange in the centre of Lisbon, and Montijo, where a new building will be erected to house the radio equipment and a tandem exchange. The equipment will be basically the same type as is used in coaxial systems.

High Marnham Handling Plant

The Central Electricity Authority has awarded a contract to Mitchell Engineering, Ltd., for the installation of coal handling plant at the new power station at High Marnham, Notts. The contract is valued at more than £500,000. The plant will include belt conveyors, screening and crushing plant, travelling bunker dischargers, and a travelling boom stacker. Mitchells will also provide a side discharge weighing-type wagon tippler of their own patent design.

New Turbo-Electric Driven Liner

The British Thomson-Houston Co., Ltd., is to supply the twin-screw turbo-electric propelling machinery, and auxiliary equipment, valued at over £1 million, for the new P. & O. 45,000-ton passenger liner which will be built by Harland & Wolff, Ltd. It is claimed that the 85,000 s.h.p. propelling machinery will be the most powerful turbo-electric drive installed in any British vessel. The two uni-directional propulsion turbines will be single-cylinder units developed from B.T.H. land machines for power stations where fuel economy and reliability are of the greatest importance.

With the engine room of the new vessel aft, leaving the midship clear for passenger accommodation, advantage can be taken of the flexibility of engine arrangement afforded by the electric drive, as there is no mechanical connection between the prime movers and the propeller shafting. Further, the electric drive will allow an improved consumption at reduced speeds by the driving of both propellers from one power unit which will operate at a greater and, therefore, more economical load than would be possible if both turbines were in service. Reversing will be carried out electrically and the full power available ahead will also be available astern for rapid manœuvring.

National Inspection Council

In our 18th January issue we reported the appointment by the National Inspection Council for Electrical Installation Contracting of twelve inspectors for England and Wales. The appointment of the two inspectors for Scotland is now

announced; they are Mr. M. Kerr (Glasgow), previously travelling supervisory engineer with a prominent firm of electrical contractors in Scotland, and Mr. J. S. Fraser (Aberdeen), for six years, until 1955, installation engineer for the North of Scotland Hydro-Electric Board, Aberdeen Area, when he took up an appointment as technical electrical engineer with a paper and board mill.

New Vitreous Enamelling Furnace

A timely change-over from oil to electric furnace firing for vitreous enamelling electric cooker parts was inaugurated last week at the Blythe Bridge, Staffs., factory of the Simplex Electric Co., Ltd., when a number of distinguished visitors were invited to see the first cooker parts emerge from a newly-installed electric furnace which was switched on to build up to the operating temperature four days previously.

The new furnace was built and installed by Metalectric Furnaces, Ltd., to supplement the factory's existing oil-fired furnaces, and is believed to be the first of its kind in the Midlands. It will enable the factory to fire up to 2,000 additional sets of cooker parts weekly. Sets of sheet metal parts, after being sprayed with ground enamel suspended in water, are hung on a continuous conveyor moving at 6½ ft/min which carries them through the long U-shaped tunnel of the furnace in 18 minutes.

In their passage through the tunnel the cooker parts go through five different heating zones each equipped with a series of nickel-chrome heating elements rising to and falling from required temperatures between 850 and 790 deg C in the 35ft long firing zones in the middle part of the tunnel. Above the entrance and exit ports are powerful fans providing a curtain of hot air to prevent heat loss from the interior. Near the furnace is a large control panel by which the temperatures required in the different zones are automatically controlled. A temperature recorder and regulator ensures that selected temperatures are constantly maintained.

The furnace is supplied from the factory's 11 kV distribution network and has a maximum load of 625 kW. It will operate continuously for 168 hours each normal working week.

After inspecting parts coming out of the new furnace and congratulating the Simplex Co. on the development, Mr. W. S. Lewis, chairman of the Midlands Electricity Board, said it was appropriate that the factory, the products of which played an important part in building up the domestic electricity load, should set an example by adopting the latest electrical methods of processing. The pottery industry in the area was showing a similar inclination and was abandoning the old bottle kilns in favour of electric kilns on an increasing scale.

Speaking at a luncheon at the factory after the ceremony, Mr. Lewis said he understood that the installation of this new furnace would increase the factory load by 18 per cent to about 2,500 kVA. As the furnace would be in continuous operation it would also improve the load factor, which had advantages both for the Board and for large consumers on maximum demand tariffs.

Coalman's Fatal Shock

At an inquest at Whitley Bay (Northumberland) it was stated that a 34-year-old coalman, James Campey, while delivering coke to a house in Beverley Park, Whitley Bay, received fatal injuries when he took hold of an electric flex passing through the coalhouse to a 100 W heater in a lavatory. An official of the North Eastern Electricity Board said he had no doubt that in many houses in the town unauthorised extensions to wiring installations had been made by amateurs. The Board laid down regulations regarding the standard of wiring and equipment, but they were difficult to enforce.

Mr. H. G. Steel, district engineer for the Board, said that the twin-flex was attached to a plug adaptor. The switch was incorrectly wired, and even when the switch was in the "off" position, one of the wires in the flex was alive. The flex had been placed through the coalhouse, and the coalman naturally reached to move it out of his way. In doing so, he must have pulled the flex out of the adaptor, and had come into contact with one of the live pins.

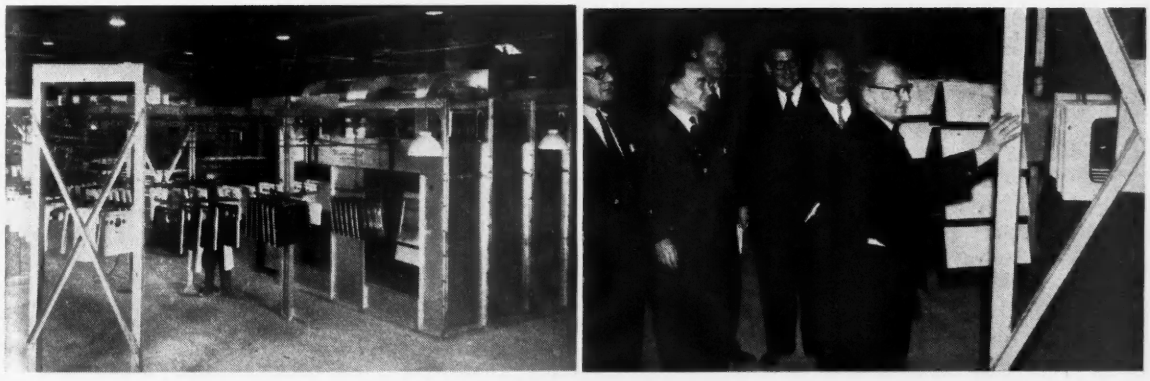
The tenant of the house, Mrs. Bonney, said that the plug had been fitted by her husband, and the length of flex had been led from it to a small heater in the lavatory to stop the system freezing.

The coroner (Mr. J. P. Dodds) returned a verdict that Campey had been accidentally "electrocuted" by grasping a live plug adaptor.

E.D.A. Agricultural Film

"Current Affairs" is the title of the latest film in the E.D.A. agricultural series produced for the British Electrical Development Association by Greenpark Productions, Ltd., in association with the Film Producers' Guild. The film, with a running time of 31 minutes, while containing a great amount of information about the use of electricity on the farm, never loses sight of the practicalities, nor of the shrewd audience of farmers for which it is primarily intended.

It tells the story of a typical small farmer with limited capital who is searching for ways and means to reduce costs and losses. Visiting the local agricultural show, he is taken round the Electricity Board's stand, where it is explained to him that since electricity is already run to the farm he should be able to make much greater use of it than he does. As a result of what he sees he installs, over the years, and well within his available capital, such equipment as electric hot water boiler and sterilising plant for the dairy, an electric hammer mill and food mixer, and a dual-purpose grass



Left: The new electric vitreous enamelling furnace installed in the Simplex cooker factory. Right: Messrs. S. Farrar (joint managing director Simplex), H. J. Gibson (chief commercial manager, M.E.B.), E. G. Plucknett (joint managing director, Simplex), Alderman E. Bennett (M.E.B.), F. W. Martin (chairman, Simplex) and W. S. Lewis (chairman, M.E.B.) watch the first cooker parts come out of the furnace

and grain drying plant. Controlled ventilation in the henhouse and automatic light switches to provide extended hours of light help to increase his egg yield. In telling the story the film ranges over other farms which he visits, where electricity is seen helping the farmer in many ways.

Copies of the film (16 mm) are available on free loan from the Association at 2, Savoy Hill, London, W.C.2.

Farmers' News Sheet

The Eastern Electricity Board has published the first issue of "Eastern Electricity Farmer" for distribution to farmers in its area. This will be published twice a year and the first issue deals with electricity in grain drying, pig rearing, on the poultry farm and on the dairy farm. The Board has 21,000 farmers connected to its system, and it is stated that new connections are at the rate of six per working day.

Electrolux Vacuum Cleaner Factory

The new Electrolux factory formally opened on 18th January by the Marquess of Salisbury at Linden Road, Leagrave, Luton, is the first building of the company to be devoted entirely to the manufacture and assembly of vacuum cleaners. Previously the cleaners were made in scattered buildings and the parts gathered together for assembly and dispatch.

Guests at a luncheon, which preceded the opening ceremony, included Dr. Charles Hill, M.P., Mr. Norman Cole, M.P., and the Mayor of Luton, Councillor F. W. Bates, J.P. During the speeches following the luncheon Sir Harold Wernher, the chairman of Electrolux, Ltd., announced the production of a new cleaner, model 62, the result of eight years' planning and development work. Afterwards the visitors toured the new factory and inspected its modern equipment.

Work on the factory began at the beginning of 1956 and within eight months the building was occupied. It covers a total floor area of 70,000 sq ft and there is a clear height inside of 14ft. Natural ventilation is possible by means of 5ft high vents up to 30ft long opened by electrically operated telescopic control gear. The whole of the roof is insulated against heat loss and the heating is by means of four plenum plants carried in the roof space. This plant permits of two changes of filtered air per hour for the entire building during winter months when natural ventilation is undesirable.

The factory is fitted with conveyors which carry the completed cleaners through an overhead tunnel to the storage and dispatch areas. At the rear of the building there is a loading dock measuring 60ft by 25ft, equipped with an overhead crane. The plating and polishing shops are provided with comprehensive plant for the extraction of fumes and dust and have acid-resisting floors. One side of the new factory is prepared for future extension and the present wall can be removed in its entirety and re-erected at the other side of the extension within a day or two of the change-over.

The architects and structural engineers were Barnes, Challen & Cross and the builders were Kyle, Stewart (Contractors), Ltd.

Industrial Efficiency and Productivity Exhibition

Provincial Exhibitions, Ltd., is organising an Industrial Efficiency and Productivity Exhibition to be held in the City Hall, Manchester, from 5th to 16th November next. The exhibition is sponsored by the Institute of Works Managers and is planned to incorporate exhibitors in production engineering, mechanical handling, scientific instruments, factory maintenance, fuel efficiency, planning and material control, office appliances, industrial health, welfare and industrial catering equipment.

Lead Disposals

The Board of Trade announced in December its intention of seeking trade advice about the best way to dispose of lead from the Board's stocks without unduly disturbing the market. These consultations have been completed and the Board has decided to sell about 30,000 tons of lead for delivery and pricing over a period of nine months beginning in March. Some 4,000 tons of this will be offered by open competitive tender and the remainder, to which special considerations apply, will be offered back to the original suppliers or their agents. The availability of tender forms for the 4,000 tons will be advertised in due course.

Noise Abatement

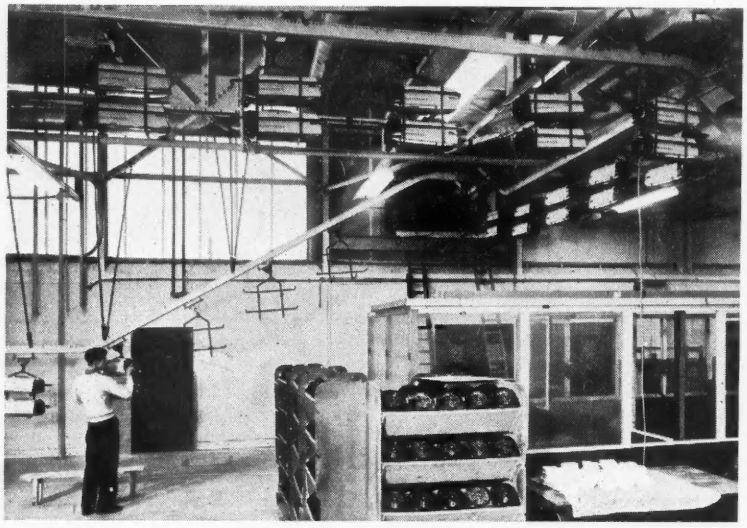
A change in the law to give local authorities power to take action against anyone making too much noise is to be sought by the Government following representations by local authorities and their representatives. This is revealed in a report by the Law Committee of the Association of Municipal Corporations. The report says that the Minister of Housing and Local Government has stated that it is the Department's intention to include a clause on noise nuisance in a forthcoming Bill. The question of extending it to cover vibration is being considered.

A spokesman for the Association stated that the main intention was to have "unnecessary, unreasonable and excessive" noise classified as a statutory nuisance. All types of noises would be covered.

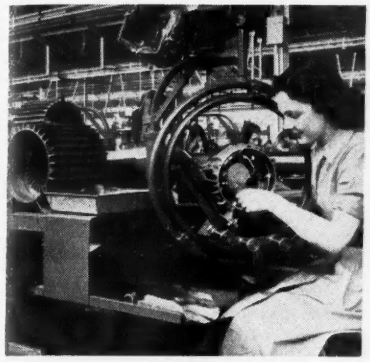
If noise is made a statutory nuisance, it is proposed that penalties of up to £5 should be imposed for not obeying an abatement order, with further fines for refusing to comply with a court order. As at present worded, the proposed clause will give a trader the defence that he has used the best practicable means for preventing or mitigating the nuisance.

Brook Film Unit

Brook Motors, Ltd., has recently organised its own unit for making 16 mm films. This is operated in conjunction with the Publicity and Photographic Departments of the company. The first production is a 20 minute black and white sound film, "Winding Journey," which covers the methods of work handling at the company's Barnsley factory. An older motor winding department is com-



In this view of the new Electrolux factory tested cleaners are being transported on a lightweight overhead conveyor, through a connecting covered bridge, to the old factory, now used as a packing and finishing stores



One of the winding benches on the electronically controlled conveyor system shown in the Brook film "Winding Journey"

pared with the electronically controlled conveyor system in the newer factory. The film also gives a brief outline of other manufacturing operations carried out before the finished electric motors are ready for dispatch, with special emphasis on the inspections and tests which are made at all stages of manufacture. The commentary is spoken by Frank Phillips and the sound-recording was done by United Motion Pictures. Copies of the film are now available on free loan from the Publicity Department, Empress Works, Huddersfield.

Works Visit

Some sixty-five members of the London Chapter of the Armed Forces Communications and Electronics Association (A.F.C.E.A.) visited the main plant of the Plessey Co., Ltd., at Ilford on 16th January. The party, which included a number of officers from the United States Armed Forces, was conducted on a tour of the works. This was followed by a dinner at which a number of Plessey senior executives, including Mr. J. A. Clark and Mr. M. Clark (directors), were present.

Power Station History

"From Holborn Viaduct to Calder Hall" is the title of a 30-page monogram by E. B. Watton, A.M.I.E.E., published by Babcock & Wilcox, Ltd., 209-225, Euston Road, London, N.W.1. In this the Holborn Viaduct power station, put into commission by the Edison concern in 1882, is claimed to be the first *real* power station in the world. As is indicated by the title, the final part of the publication is devoted to the Calder Hall nuclear power station, with particular reference to the B. & W. heat exchangers. In between a number of the achievements of Babcock & Wilcox are briefly described and the whole is profusely illustrated.

Batteries for British Railways

Nearly 300 of the 337 diesel main line and shunting locomotives ordered for British Railways will be fitted with engine starting batteries made by the D.P. Battery Co., Ltd. The 1955 programme for 171 main line locomotives includes 131 for which the company will supply 48-cell batteries from its new "Kathanode" "R" range and all the 166 diesel-engined shunting locomotives to be built under the British Railways 1957 programme will be similarly equipped but with 40-cell batteries. In addition, the D.P. Co. has received orders for 136 batteries each of 40 cells to be installed on the 6-car and 2-car sets being built for the Southern Region's London-Hastings line.

Trade Announcements

Heating Investments, Ltd., 45, Church Crescent, Finchley, London, N.3, have been appointed southern area agents by **Calidec, Ltd.,** for its floor-warming system.

Cambridge Instrument Co., Ltd.—Mr. W. J. Cole, who has represented the company in the Liverpool area for the last 27 years, has retired. He is succeeded by Mr. K. W. Trevatt, 2, Hightor Road, Woolton, Liverpool.

Drake & Gorham, Ltd., have announced that the group is being reorganised and that this involves the voluntary liquidation of **Drake & Gorham Wholesale, Ltd.,** thus allowing for the extension of the engineering activities of the other subsidiaries both at home and overseas. Drake & Gorham Wholesale, Ltd., cannot accept orders after 15th February.

To cope with increasing business in the North of England, **Ekco Electronics, Ltd.,** have appointed Mr. A. H. Johnston as a nucleonics sales engineer and he will be based at the company's Manchester offices at 115, Jersey Street, Ancoats, 4 (telephone: Collyhurst 4421/3).

Dowding & Doll, Ltd., have appointed Mr. A. J. Thorning, 346, Kensington High Street, London, W.14, as their sales representative for the West Country and South Wales areas.

Packaging Exhibition

More than 200 manufacturers of packaging plant and materials are represented at the Packaging Exhibition now being held at Olympia, London.

During the exhibition, which closes this evening (Friday), there has been a Convention in the Olympia Conference Hall, organised by the Institute of Packaging.

The exhibition is of interest not only for the many methods demonstrated for the packaging of a wide range of electrical goods, but also for the application of electricity to the operation of the various types of equipment displayed. These include machines for packing, filling, weighing, bagging, capping, wrapping, wire-stitching, taping and stringing. The new "Bunn" package tier exhibited by the Sheridan Service Co., Ltd., can handle any shape or size of bundle up to 25in cube dimension, and ties a double-wrap or cross-tie of sisal twine in less than two seconds. It is operated by a ¼ h.p. single-phase motor.

Manesty Machines, Ltd., show their "Fitz-Mill" all-purpose comminuting machine for granulating, pulverising, and milling of ointments and sizing of crude drugs which, it is claimed, saves as much as 80 per cent in time compared with older methods. Its basic principle is a combination of screen size and speed. The stainless steel screens are available in perforated sizes ranging from 0·015 to 1·5in openings, and speeds from 800 to 5,000 r.p.m. can be obtained by the use of special pulleys. Standard electrical equipment includes a 3, 5 or 7½ h.p., 1,500 r.p.m. 3-phase motor, complete with totally enclosed air-break contactor type starter.

A new bottle crating and de-crating machine capable of handling 3,600 bottles per hour is shown by Dawson Bros., Ltd., while the Thomas Hill Engineering Co. (Hull), Ltd., introduce the "Grangemouth Hydro" bottle cleaning machine designed to deal with bottles that need more vigorous cleaning treatment, in particular to provide for label removal and disposal.

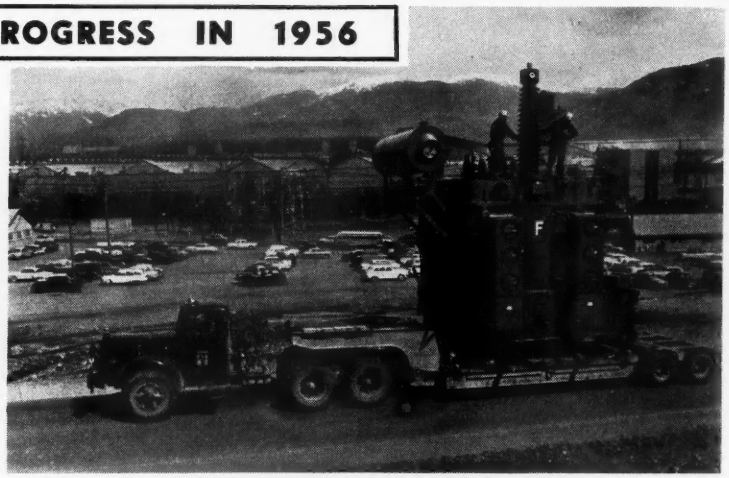
At the stand of Samuel Jones & Co., Ltd., can be seen new electric labellers designed for use with pre-gummed labels, a foot-controlled, two length, electric tape shooter and an electric dispenser for tacky labels in sheets and rolls. An electrically operated continuous can sealer (Minnesota Mining & Manufacturing Co., Ltd.) incorporates a tabbing attachment and an automatic tape splicing device.

Electronic metal detection equipment is of importance in the confectionery, bakery and medical trades and among firms that exhibit this type of equipment are the Automa Engineering Group, Cinema-Television, Ltd., and Goring-Kerr, Ltd. The last named company have on view their latest "S.J.M." model, believed to be the smallest and cheapest of its type. No setting up is required and once installed it will operate indefinitely without further attention.

The problem of trying to reconcile the stock of raw materials with the packaged output leaving the factory is claimed to have been solved by the Solartron Electronic Group, Ltd., who have produced the "Electronic Clerk." This device when connected to the company's "Solarcheck" range of check-weighers in a production line will show on the dials of a counting device or through the output of an electronic digital computer, the exact weight of any package from $\frac{1}{10}$ oz upwards.

MANUFACTURING PROGRESS IN 1956

Activities of Ferranti, Ltd.



A 37 MVA, 275 kV Ferranti transformer approaching the site at Kemano, British Columbia, Canada

DURING 1956 the production of large power transformers by Ferranti, Ltd., has continued at the high level established in recent years. Eighty-nine large power transformers were dispatched, including for supply authorities at home, two 120 MVA, 275 kV units; three 75 MVA, two 72 MVA, eight 60 MVA and nine 10 MVA, 132 kV units, and 28 system transformers. Orders for the home market include two 120 MVA, 275 kV; two 75 MVA, seven 72 MVA, four 60 MVA, two 45 MVA, three 30 MVA, twenty-one 10 MVA, 132 kV transformers; and 30 system transformers for the Central Electricity Authority, South of Scotland Electricity Board and the Area Boards.

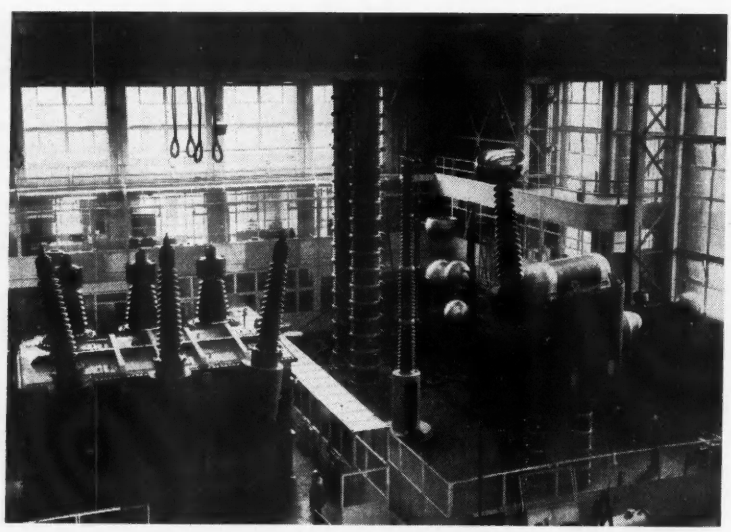
Transformers exported included the second 111 MVA, three-phase bank of 275 kV transformers and the second 213 MVA, three-phase bank of 301 kV generator transformers for the Aluminum Company of Canada. The last-mentioned is believed to be the largest bank of transformers with aluminium windings in the world, and is installed in the underground power station at Kemano, British Columbia. This brings the total loading of transformers supplied to this customer in recent years to 719.

Other export contracts completed during the year include two 169 MVA, three-phase banks of generator transformers for the U.S. Army Corps of Engineers, McNary Dam Project, Oregon; two 10 MVA, 110 kV transformers for the U.S. Bureau of Reclamation; and a number of contracts for transformers of up to 35 MVA for South Africa, India and New Zealand.

The outstanding order received during the year was for 330 kV transmission transformers for the Federal Power Board of Rhodesia and Nyasaland for the Kariba hydro-electric scheme on the Zambesi River. This contract, comprising two 120 MVA and ten 60 MVA, three-phase transformers, is the largest overseas transformer order ever to be placed in Great Britain, and is the first contract for 330 kV, three-phase transformers to be awarded to a British manufacturer.

Other overseas contracts include nine 60 MVA, 132 kV transformers for the Electricity Commission of New South Wales; one 60 MVA, 132 kV, three-phase bank for the Electricity Supply Commission, South Africa; one 100 MVA, 110 kV, three-phase bank and spare unit for the State Hydro-Electric Department, New Zealand, and one 80 MVA, 154 kV, three-phase bank and spare unit and four 12 MVA, 17 kV, three-phase transformers for Tennessee Valley Authority, U.S.A.

The heavy demand for distribution and industrial type transformers has continued and the production of these is now being concentrated in a new factory at West Gorton, Manchester. To achieve the maximum advantage from cold-rolled grain-oriented steel, a simple and rugged core has been developed for single-phase transformers up to 25 kVA, 11 kV. This is known as the lock-wound core and its superior magnetic properties result in a considerable reduction in iron losses compared with the conventional core of interleaved construction. Lock-wound core transformers are now in full production and are available for delivery from stock, together with a comprehensive range of transformers to the British Electricity Specification T.1. Development has also been made in connection with fire-resistant transformers, both



A 120 MVA, 132/275 kV Ferranti auto-transformer for the C.E.A. and a 1 MV, 700 kVA high voltage testing transformer for the N.P.L. undergoing tests at Hollinwood

with Class " H " insulation and non-inflammable coolants.

Among outstanding installations of h.v. test plant is the 1 MV 700 kVA transformer at the National Physical Laboratory, which is believed to be the largest outdoor h.v. transformer in the country. It is mounted on four columns of porcelain insulators and operates with the tank 500 kV above ground potential. Other h.v. test plant delivered during the year includes 2·8 MV and 2·4 MV impulse generators to the British Electrical and Allied Industries Research Association and Enfield Cables, Ltd., respectively, and 330 kV 100 kVA and 400 kV 800 kVA a.c. test equipments to Manchester College of Technology and Standard Telephones & Cables, Ltd.

Among orders received are an 800 kV, 2 MVA a.c. test equipment for B.I.C.C., Erith, a 600 kV 24 MVA a.c. test equipment for Enfield Cables, a 400 kV 16 MVA a.c. test equipment and a 1,000 kV d.c. mobile testing equipment for the Pirelli-General Cable Works, Ltd., and a 300 kV, 24 MVA a.c. test equipment for Anaconda Wire & Cable Co., New York. Orders for impulse generators include a 3·2 MV equipment for B.I.C.C., Erith, a 1·2 MV equipment for Siemens Bros., and an 800 kV equipment for Pirelli Cables & Conduits, Ltd., Canada.

Manufacture of moving coil voltage regulators for transmission and distribution systems at home and abroad has continued at a high level as well as the production of regulators for special industrial and laboratory applications. Considerable interest in improving power factor is still being shown, and many orders have been secured for static capacitors and associated control equipment.

Transatlantic Telephone Cable

Proceedings at Joint British-American-Canadian Meeting

AN historic joint meeting between the Institution of Electrical Engineers in London, the American Institute of Electrical Engineers in New York and the Engineering Institute of Canada in Montreal took place on 24th January, the three places being linked by the recently completed transatlantic telephone cable, which itself was the subject of the symposium of twelve papers by 33 authors (see our last issue, p. 164).

Sir Gordon Radley, K.C.B., C.B.E., Ph.D.(Eng.), President of the Institution of Electrical Engineers, presided at the Institution in London where, with an overflow meeting, the attendance was 700; Mr. Dean Coover, President of the American Institute of Electrical Engineers, presided in New York, where the attendance was 400; and Mr. McKillop, President of the Engineering Institute of Canada, presided in Montreal, where the attendance was 250. The proceedings included a demonstration of the transmission of recorded music, that originating in London being heard in New York and Montreal and that originating in New York being heard in London and Montreal.

The meeting began with an exchange of greetings between Mr. Coover, Mr. McKillop and Sir Gordon Radley. Sir Gordon acted as chairman of the joint meeting.

Increased Traffic Handling Facilities

The subject of the meeting was introduced by Dr. Mervin J. Kelly from New York. He dealt with the developments in submarine cable design since the successful laying of the first telegraph cable between the British Isles and Newfoundland 90 years ago. He said that the new cable increased the capacity of the present transatlantic radio telephone service by a factor of four. Success of the cable removed a limit on traffic handling facilities which was fast approaching as almost all of the usable frequency space of the radio spectrum had now been occupied. With that limit removed, it was possible to look ahead to rapid increases in traffic promoted by available and reliable communication. Additional cables were doubtlessly ahead and, as technical advances matured to a point where they were sufficiently reliable for use in a submarine cable system, one could anticipate broader bands and the incorporation of new devices such as the transistor in future cables. He concluded with a tribute to the foresight and early contributions made by Dr. Oliver Buckley and his early associates.

Mr. R. J. Halsey, assistant engineer-in-chief of the British General Post Office, then described from London broadly the overall plan of the system, and Mr. E. T. Mottram, director of transmission systems development, Bell Telephone Laboratories, New York, described how the system was brought into being. The connection between Newfoundland and Nova Scotia was then described by Mr. R. G. Griffith, chief engineer, Canadian Overseas Telecommunications Corporation, from Montreal.

The reasons for the selection of the terminal points of Oban in Scotland and Clarenville in Newfoundland were explained from London by Captain W. H. Leech, submarine superintendent of the British Post Office, and the problems at the Newfoundland end were dealt with by Mr. J. S. Jack, of the Long Lines Department of the American Telephone & Telegraph Company, in New York.

The use of the repeaters in the two transatlantic cables was described by Mr. H. A. Lewis, director of outside plant development, Bell Telephone Laboratories; the design of the cable was dealt with by Mr. A. W. Lebert, of the Bell Telephone Laboratories; and the electrical design of the repeaters was described by Mr. T. F. Gleichmann, of the Bell Telephone Laboratories. Finally, Dr. R. A. Brockbank, of the British General Post Office, described the work on the system for the Clarenville-Sydney Mines link.

Sir Gordon Radley, summing up, said that when the plans for the transatlantic cable were formulated in 1953, the target date for service was set as December, 1956, a target that was beaten by several months. No specifications for the system existed. The British factory that was to make nearly all the submarine cable was little more than a series of sheds, damaged by bombing and due to be stripped, largely rebuilt, and equipped with the most modern cable-making machinery in the world. The American factory which made all the transoceanic repeaters was little more than a shell needing to be

reconditioned, air-conditioned, and equipped to accommodate over 300 highly skilled people.

Carrying out the objectives in the short time allowed was in itself a tribute to the diligence and co-operation displayed on both sides of the Atlantic.

Immediately after the opening of the new service, the traffic to both New York and Montreal increased substantially and now stood at about twice the pre-cable level to New York and about three times to Montreal. That was how the public had reacted to a reliable high-grade telephone service across the Atlantic in the short time that had elapsed since the opening date. How much further the traffic would increase remained to be seen, but it was already clear that we must consider the pattern of the next transatlantic telephone cable and of transoceanic telephony in general.

Tribute to Engineers

Sir Archibald Gill, who preceded Sir Gordon as engineer-in-chief of the G.P.O., said that one outstanding point which needed to be stressed was the commercial courage shown by those responsible for putting the project in hand. They had heard interesting details of the engineering studies, and there must be corresponding studies by those concerned with traffic growth and the financial side of the undertaking. At present H.M.T.S. *Monarch* was the only vessel capable of laying such cables. It was gratifying to know that when she performed her recent task in the North Atlantic her inbuilt qualities were employed to their utmost, which exonerated him from the charge of being unduly lavish about the requirements in respect of the vessel.

Mr. T. W. Eadie, president of the Bell Telephone Company of Canada, speaking from Montreal, said that the remarkable growth in transatlantic calling which had followed the opening of the new cable link suggested that the more advanced techniques occupying the British Post Office and the Bell Telephone Laboratories must find their place in the international communications network in the not-too-distant future.

Mr. Bowie, president and general manager of the Canadian Overseas Telephone Corporation, paid tribute to the engineers, saying that the achievement was their product, and emphasising that continued effort on the part of engineers would be required.

Mr. Chester Lawton, general plant engineer, International Communications, Western Union Telegraph Company, spoke of the development in surveys. The joint meeting was then closed by the three presidents in turn.

A brief discussion then took place in London. Brigadier L. H. Harris said that one got the impression from the papers that all that could be said about the project had been said and that it constituted a complete transatlantic telephone cable manual. Nevertheless, many felt that the human story of that great enterprise still remained to be written.

Dr. E. W. Smith said that the success of the enterprise must not leave those concerned in a complacent mood because success, like failure, must point to improvements. There was, for instance, the matter of the so-called "laying effect." Two years previously he had called attention to a possible cure for that through the adoption of a solid conductor instead of a composite one. He concluded by saying that it had been shown that mathematical factors could be wrapped up together in a parcel by British experience so that the result could be handled, coiled and laid and, if need be, recovered from the ocean depths in 20 years' time.

Mr. F. C. Wright said that when the first telegraph cable was being laid across the English Channel about 100 years ago, one of the newspapers of the day reported that it was bound to fail by reason of abrasion caused each time the end was tugged in order to pass information to the other side. The cable had, in fact, failed, and as a result of abrasion, no doubt to the greater glory of the editor! From what they had heard that evening, it was clear how far they had moved from that idea. What one needed to remember was how those concerned with determining what was the right step to take at each stage of the planning and realisation of the project were tugged in one direction or another in trying to reach the right decision. It was in the taking of those decisions—even if, as in the case of the editor, some were perhaps right for the wrong reason—that one appreciated the real skill which constituted the background to the project. With the new cable it was difficult to tell whether they were talking to New York or Newcastle, Montreal or Montrose. He did not believe any higher tribute could be paid to the success of the project and the skill of those responsible for it.

Mr. R. Krzyczkowski referred to the economic uniqueness of the transatlantic submarine cable venture. He said that the potential demand for communication services between America and Europe was much greater than could be expected anywhere else in the world. Consequently, from the economic point of view, it was difficult to foresee many similar undertakings being carried out elsewhere.

Sir Gordon Radley, summing up the discussion, said that the project was not the end but the beginning. In their future projects they wanted to make use of modern high-performance valves. That meant duplicate amplifiers. They wanted to use both-way cables, which were more efficient on most routes. These requirements meant larger and rigid housings for repeaters. The problem in front of them was that of devising some form of cable-laying machinery which would get those housings from the ship to the bottom of the ocean as part of a continuous cable-laying process. To that task they were bending all their efforts. On its solution would depend the rate at which they would go forward.

Dr. R. C. G. Williams, chairman of the Radio and Telecommunications Section, in expressing thanks to the authors, said it was rare in a lifetime to be present when history was made, but those present had had that opportunity at that joint meeting. The fact that such a meeting had occurred within almost a lifespan of the invention of the telephone was a measure of the speed at which telecommunications was developing. They looked forward to seeing before many years had elapsed the next great milestone in progress in which they would be linked for such a meeting not only in sound but in vision.

High Conductivity Copper

THE wide range of technical publications of the Copper Development Association has been extended by the addition of a 54-page booklet entitled "High Conductivity Copper Alloys." Four copper alloys are dealt with, cadmium-copper, chromium-copper, silver-copper and tellurium-copper, which have many applications in the electrical industry and, in general, for purposes where high electrical and thermal conductivities are required. The composition, production, physical and mechanical properties, etc., of each alloy are discussed. There are 25 useful tables, as well as equilibrium diagrams, while photographs illustrate typical applications of the four alloys. Copies of this booklet are available, free of charge, on application to the Copper Development Association, 55, South Audley Street, London, W.1.

Standard A.C. Motors

Review of Recent Trends in Design

By P. FIRTH, B.Sc.(Eng.), A.M.I.E.E.*

DURING recent years considerable progress has been made in the development of small integral horse-power ventilated a.c. induction motors. This development has been influenced largely by the trend towards the standardisation of outputs and fixing dimensions, coupled with the introduction of new insulating materials having a higher thermal endurance, and occupying less space.

Manufacturers have been quick to appreciate the significance and practical value of these factors, particularly in view of the latest draft B.S. Specification CW(ELE) 6246, which provides a dimensional standard for ventilated machines. This will enable the machine requirements for this country to be reconciled with those of the American and Canadian markets—a fact which is of particular importance.

It must also be borne in mind that in parallel with these advances, a great expansion in the rate of electrifying all manner of drives has been taking place with the result that the use of copper and sheet steel in the United Kingdom has increased enormously during the last eighteen years. According to Quin's Metal Handbooks, the consumption of refined copper in the United Kingdom in 1938, excluding remelt or scrap, was 258,800 metric tons, rising to 357,000 tons in 1949 and 504,000 tons in 1955. Iron and Steel Federation statistics show that the total United Kingdom production of steel sheets under 3 mm thick in 1938 was 816,000 tons rising to 1,394,000 tons in 1949 and 2,249,000 tons in 1955. The output of electrical sheet in 1949 and 1955 was 116,000 tons and 182,000 tons respectively.

From statistics of this kind taken over a fairly long period, it becomes possible to see the general trend of the demands of production, and to gauge the importance to the British electrical industry of keeping imports of copper down. It follows also that in future the industry as a whole must play its part to ensure, wherever possible, that less material is used for a given job than has been the case in the past. Indeed, leading manufacturers have already taken steps to obtain greater efficiency in the use of materials, more exacting designs, and the use of the latest materials in electrical machines. For example, one manufacturer has recently introduced a new range of standard a.c. ventilated motors and motors are anticipated shortly from other manufacturers.

Factors Affecting Design

In view of the foregoing it may be worth while to discuss the factors which have affected developments in the design of the smaller ventilated a.c. induction motors, up to the present day. From 1936 motor manufacturers worked to B.S. 168 for small- and medium-size machines, which allowed a maximum winding temperature rise of 40 deg C with Class A insulation, and continuous rating for ventilated machines. It permitted sustained overloads of varying durations which would be expected to take the maximum temperature rise to about 55 deg C. This specification remained in force until mid-1955, when users and manufacturers agreed to its revision along with related specifications, and to incorporate them into a single document issued as B.S. 2613:1955. The new specification cancelled the use of continuous rating permitting overloads for ventilated machines above 50 h.p. per 1,000 r.p.m., and at the same time, forecast the extension of this cancellation to all machines in the integral horse-power range.

In 1939 discussions took place on the choice of a common set of machine dimensions, but the extent of the standardisation was not sufficient to make the results of great practical importance. The Lemon Committee was set up by the Government in 1948 to investigate simplification and standardisation within the engineering industry. One of the conclusions of this Committee was that the standardisation of fixing dimensions for motors was desirable, and with the strong backing of the Machine Tool Trades Association, representing a large section of the users, a range of standardised totally enclosed fan-cooled motors was prepared. In February, 1954, the relevant British Standard was issued under the reference B.S. 2083. This specification, which is still current, standardises outputs and leading fixing dimensions for machines from ½ h.p. eight-pole to 25 h.p. two-pole. Since there was no comparable standard for ventilated machines, it became expedient that discussions should take place on the provision of a dimensional standard for these machines.

Maximum Insulation Temperature

The basis of the considerations, which were discussed and agreed upon, hinged upon choice of rating, temperature and class of insulation. Many years ago the International Electrotechnical Commission formulated maximum temperatures (hot spot) for recognised classes of insulation. These were 105 deg C for Class A and 130 deg C for Class B insulation. Post-war development has since made available synthetic enamel covered wires and synthetic insulation, in both film and woven fibre form, which are recognised as having a higher thermal endurance than Class A materials. It was agreed that the recognised maximum temperature for these materials could be 120 deg C with confidence. Accordingly, to bring the position up to date on British Standards, the B.S.I. issued a new specification for insulating materials—B.S. 2757:1956, to include this new group of materials under the heading of Class E insulation.

Reviewing the new B.S. 2757 in an article entitled "The Classification of Insulating Materials" published in the *Electrical Review* of 13th July, 1956, Mr. R. Snadow explained the provisions of the new specification. It was stated that the dependence upon temperature of the life of electrical apparatus was related to the thermal endurance of the insulation, and it was predicted then that some Class A motors might be superseded by motors having the newly agreed Class E insulation.

Continental countries have already adopted higher temperature rises. For example, the latest issue of the German specification covers a temperature rise of 75 deg C measured by resistance for Class E insulation. This is closely comparable to a rise of 65 deg C measured by thermometer. In addition, it is known that leading

* Crompton Parkinson, Ltd.

American engineers are interested in higher ratings and associated higher temperature rises.

In view of the foregoing, the reasons for a final decision being taken in this country, to produce machines for continuous maximum ratings, 65 deg C maximum temperature rise and with Class E insulation, may be summarised as follows:—

(1) The availability of a suitable class of insulation.

(2) The desirability of the more efficient use of materials in the face of increases in the use of copper and sheet steel.

(3) The international competitive position which demands a strong home market working on similar limits.

Choice of dimensions is a further important consideration as it enables manufacturers in this country to use the American new N.E.M.A. dimensions established in 1954, but with one step of output larger than is used by the Americans for a given set of fixing dimensions. Appropriate adjustments were made to the shaft size to meet the higher torque.

Two exceptions have been made where this relationship with the American table of outputs breaks down and these are:—Firstly, that the up-rating of the N.E.M.A. frames would demand a smaller centre height for the lower range of outputs, since there would otherwise have been too many outputs in the smallest diameter of the proposed range. Secondly, it was considered that any increases in the outputs above the American figures for the smaller sizes at low speeds would not be technically sound. Consequently, for the smaller machines at low speeds, the chosen British outputs are the same as the American outputs, not one step higher. In addition, two new sizes of machines have been introduced with one new centre height, namely, frames 162 and 164.

Thus British manufacturers are able to offer new N.E.M.A. dimensions and outputs at 40 deg C temperature rise and 60 c/s with only minor modifications to the design, such as the smaller shaft extension for a given frame size for the American and Canadian markets.

The dimensions of three-phase motors with ventilated enclosures, as specified by the draft B.S. CW(ELE)6246, are generally similar to the American new N.E.M.A. standard MG1-1955 but with the adjustments previously mentioned. The scope is stated to be:—Continuous maximum rating; Class E insulation; maximum of 65 deg C temperature rise in an ambient of 40 deg C; ventilated enclosures; foot, flange or skirt mounting; and three-phase, 50 c/s up to a maximum voltage of 650. The range of outputs covered is from ½ h.p. at 750 r.p.m. to 50 h.p. at 3,000 r.p.m.

It is confidently thought that users will welcome the new specification and find that the machines covered by it will meet their standard requirements accurately and economically.

Electrification of a Yorkshire Quarry

WHEN X.L. Granite (Ingleton), Ltd., moved to a new site half-a-mile away in 1954 it was decided to install individual electric motor drives instead of the diesel engine drives used on the original site and the electrification scheme was placed in the hands of Crompton Parkinson's Contract Department. The new crushing and screening plant has now been in operation since June, 1955, and the output of "Ingleton" granite, which is used extensively for road repairs, has been greatly increased.

From a 10 ton hopper the granite is fed by a 30in apron feeder driven by a C.P. "Klosd" induction motor into a double toggle primary crusher, a 30in by 18in Blake breaker manufactured by Goodwin & Barsby. This is V-belt driven by a 60 h.p., 400-440 V, totally enclosed, fan-cooled, slip-ring motor with an Allen West hand-operated starter. The product from the primary crusher is taken by belt conveyor to a double-deck vibrating screen, where the $+1\frac{1}{2}$in and $+\frac{3}{4}$in materials are separated, the latter being fed direct to a Marsden granulator and the oversize material to surge bins. From the surge bins the $+1\frac{1}{2}$in material is passed by two plate feeders into granulators and reduced to $+\frac{3}{4}$in size.

The incoming supply to the site is provided by an 11 kV cable connected to the North Western Electricity Board's overhead line. From a 300 kVA substation transformer single-core cables feed through the supply authority's input meters to a Crompton Parkinson Klad "A" switchgear unit having a breaking capacity of 25 MVA, housed in an adjacent switchroom. Supplies from this unit are taken to a six-way high-rupturing-capacity distribution board feeding a main motor sequence-control panel, which controls nine C.P. motors arranged for sequence interlocking and employing contactor type control gear. This arrangement is necessary to ensure that the conveyors and screening plant, which are fully integrated in the process, are started in the proper sequence. In addition, it also ensures that if any item of equipment fails, the preceding items of equipment in the system are also stopped, in order to halt the flow of material. At suitable positions on the plant, emergency push-buttons are provided to stop the raw material feed conveyors in the event of an emergency or blockage of the system.

The two Goodwin & Barsby 36in by 5in granulators which feed the returns conveyor are each driven through V-belts by a 30 h.p. totally-enclosed, fan-cooled, slip-ring motor with Allen West hand-operated starters provided with no-volt and overload releases.

With the exception of the 30 h.p. granulator motors and the 60 h.p. slip-ring motor for the primary crusher, all the remaining motors are squirrel-cage, totally-enclosed, high torque, fan-cooled machines operating on a 400/440 V, three-phase, four-wire, 50 c/s supply. In view of the inducement made by the N.W.E.B. of lower tariffs for improved power factor, the larger motors are fitted with separate capacitors; for all motors on the automatic panel a single 10 kVAr capacitor is employed. By this means the power factor is maintained at an average of 0·96 lagging.

Platinum Metals Review

TO provide engineers, chemists, metallurgists and other users of platinum with a source of current information on the properties and industrial applications of this and associated metals, a new quarterly journal entitled "Platinum Metals Review" is being published by Johnson, Matthey & Co., Ltd., Hatton Garden, London, E.C.1, the sole refiners and distributors of platinum metals from the Rustenburg platinum mines in South Africa.

The first issue of this journal contains articles on subjects ranging from the protection of chemical process equipment to electrodeposited rhodium in coaxial radio-frequency circuits. Other articles deal with a thermocouple for high temperatures, platinum metals in catalysis, and the creep properties of platinum metals and alloys. There is also a comprehensive service of abstracts of current literature on the platinum metals and their alloys. In addition, the first number contains an article describing operations at Rustenburg platinum mines, the world's largest producer of platinum.

ELECTRIC SPACE HEATING

Plenum Ventilating and Air Conditioning Systems which Incorporate Electric Heating

By W. P. JONES, A.M.Inst.F., A.M.I.H.V.E.

WHEN considering electricity as a heating medium in ventilation and air conditioning applications, it is first necessary to have a clear idea of the meaning of certain terms.

Although used in a loose way sometimes, and although the word " plenum " has a special meaning of its own, the expression " plenum ventilation " has a certain unique significance. When a building is heated the heat losses occurring through its structural fabric are offset by an input of heat from sources inside the building. Commonly, such sources are cast iron radiators of the orthodox type, using low pressure hot water as a heating medium. These radiators also have to warm the outside air which infiltrates into the building under and through doors, and around windows. A plenum ventilating system does more than just offset the fabric losses, it also brings in and warms fresh air, in quantities greater than would otherwise naturally infiltrate. Such a system must comprise at least the following:—Fan, filter, heater and distributing ductwork.

It must be appreciated that heat losses occur because the air temperature within the building is higher than that prevailing outside. An internal air temperature of about 65 deg F, at a height of about 5ft above floor level, is generally regarded in this country as being comfortable for sedentary workers. A plenum ventilating system would arrange that this condition was maintained in a room by supplying air to the room at a temperature in excess of 65 deg F. The quantity of air supplied would cool to 65 deg F as it diffused throughout the room, and in doing so would offset the heat losses. There is in fact an inverse relation between the quantity of air supplied and the difference between its temperature and that prevailing at the 5ft level in the room:

(Air quantity) × (temperature difference) is proportional to the heat loss.

The plenum system might be regarded as a rather restricted example of the air conditioning system. With full air conditioning one maintains in a room during summer and winter a comfortable level of both temperature and relative humidity. This implies offsetting heat losses and moisture gains in winter, and heat gains and moisture gains in summer. Moisture gains occur during both seasons since, in the case of comfort conditioning, their source is the evaporative heat loss from the occupants of the room being conditioned.

Thus the air conditioning system has to supply air which is drier and cooler in summer, and drier and warmer in winter, than the air in the room—if the condition of the room air is to be maintained. Fig. 1 is a diagrammatic representation of an air conditioning system and indicates graphically the manner in which the condition of the air, with respect to temperature and moisture content, changes during its passage through the plant.

Role of the Heater Battery

The plant shown in the figure follows the common practice of extracting some air from the room, at condition R, combining this with fresh air, at condition O, and passing the mixture through the conditioning part of the installation comprising an air washer and an after heater battery. It can be seen that air enters the washer at a mixture condition M, and leaves it at condition W. During this passage through the washer the air has been cooled and dehumidified, that is, moisture has been condensed out of the air by reason of its having come into intimate contact with low temperature spray water.

Air leaving the washer must have the same moisture content as that required of the supply air (condition S). This is necessary so that the air supplied to the room may absorb the moisture gains occurring there and maintain the required relative humidity. Clearly, the after heater cannot add to the absolute amount of moisture present in the air, although of course the relative humidity reduces as the temperature of the air is increased during its passage through the after heater. This can be verified by referring to Fig. 1.

It can be further seen that the air absorbs heat from the after heater. Air enters the heater at condition W and leaves it at condition S. The value of the supply air temperature S is the physical property of the air

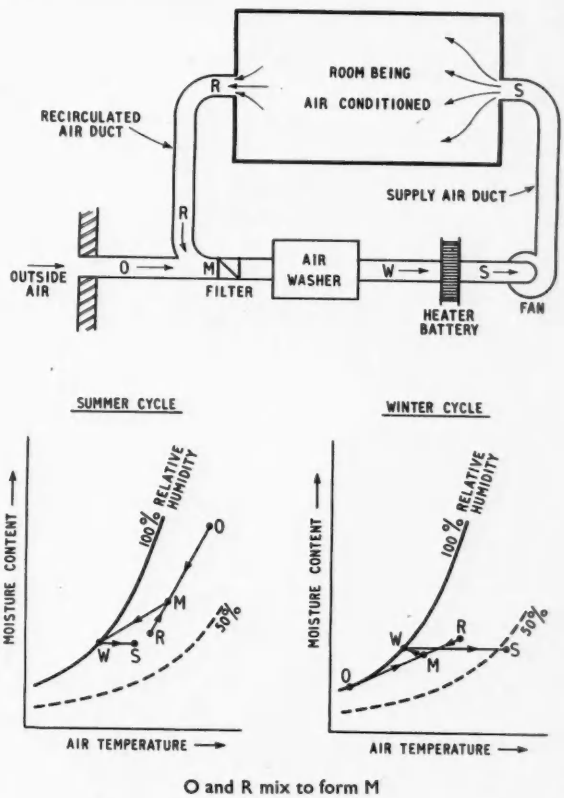


Fig. 1.—Typical air conditioning plant. In order to maintain condition R in the room, air is supplied at condition S, lower in moisture content than R, lower in temperature for summer operation and higher in winter

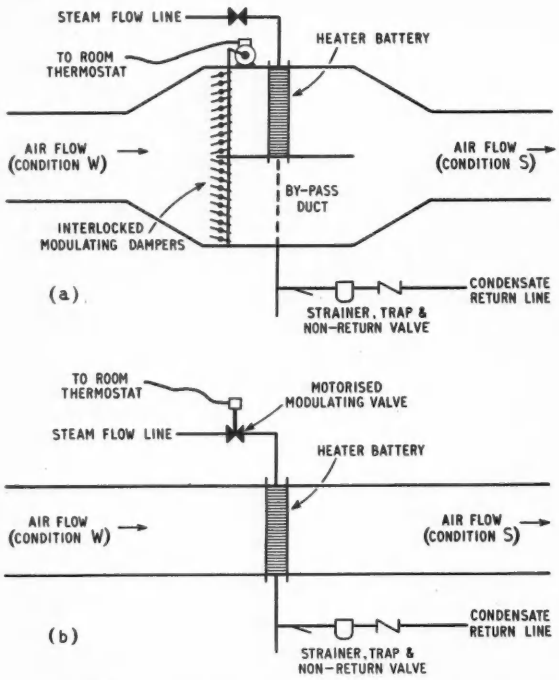


Fig. 2.—Alternative methods of controlling the output of a steam heater battery

(a) Louvred dampers are interlocked. Those covering the face of the air heater open as those across the by-pass duct close, and vice versa. Heater output is controlled by varying the air flow over the heater and this affects the condensation rate inside the heater battery

(b) A modulating valve varies the flow rate of steam to the heater. The air flow rate is constant

supplied to the room, determining the temperature maintained there. If the heat gains (in summer) or the heat losses (in winter) to or from the conditioned space vary, then the supply air temperature must be made to vary correspondingly. The heater battery is the piece of equipment which regulates the supply air temperature in this fashion. It follows that the output of the battery must be large enough to cope with the worst expected set of conditions, and that further, its output must be capable of variation at the dictates of some controlling device such as, for instance, a thermostat, placed in the room or in the recirculation duct from the room.

Heating Media

Although there are several methods of heating, for example steam, low pressure hot water, electricity, high pressure hot water, gas and oil, only the first three are used extensively.

Hot water and steam have certain undoubted advantages, the most notable of these being the ease with which a full modulating control may be obtained over the heat output of the battery. In the case of hot water this is achieved by means of a motorised modulating valve in the flow line to the battery. A thermostat suitably positioned, usually in the recirculation duct, responds to fluctuations in room temperature by controlling the amount of valve opening. This regulates the flow of water through the battery, which in turn governs the heat output of the plant. Steam is similarly controlled, a modulating valve again being used to vary the amount of steam flowing into the heater tubes. The condensation rate inside the battery governs the output, the rate depending upon, amongst other things, the temperature and velocity of the air flowing over the outside of the battery tubes. It should be realised that without air flow, condensation cannot occur, and so no steam is used. It is on this point that one may discern a big difference between heaters using steam and those using electricity. The steam battery can be controlled by by-passing air around it (see Fig. 2), whereas the heater using electricity cannot. If the air flow past an electric heater battery is reduced then the surface temperature of the resistances will rise in an endeavour to compel the air to accept the same amount of heat as before.

Electricity as a heating medium for air heaters is often considered to have two disadvantages, control over output, and running cost.

With regard to control one has to decide just to what extent one needs full modulation of temperature. Human beings are not unduly sensitive to temperature change, although sensitivity varies considerably from individual to individual. It is likely that no one can detect changes of air temperature of less than 1 deg F and that changes of more than 5 deg F in the vicinity of 65 deg F are apparent to all. It is possible, then, that by dividing up the battery output into a number of sections or steps (which may or may not be equal) one might achieve a degree of control which would be more than satisfactory, without the cost of voltage variation.

The question of running costs is outside the scope of this article, but one must remember that certain outstanding advantages which electricity possesses are paid for in the higher costs. The potential user of the electric heater battery should not overlook the fact that the costs include the value of such advantages as cleanliness, no fuel storage space, no ash removal, and so on.

A further point, worthy of consideration when the question of adverse running costs arises, is that distribution and generation costs vary from place to place over the world, and that favourable rates may at times be obtained, making the electric heater battery a very good proposition.

Electric heating has many undoubted advantages.

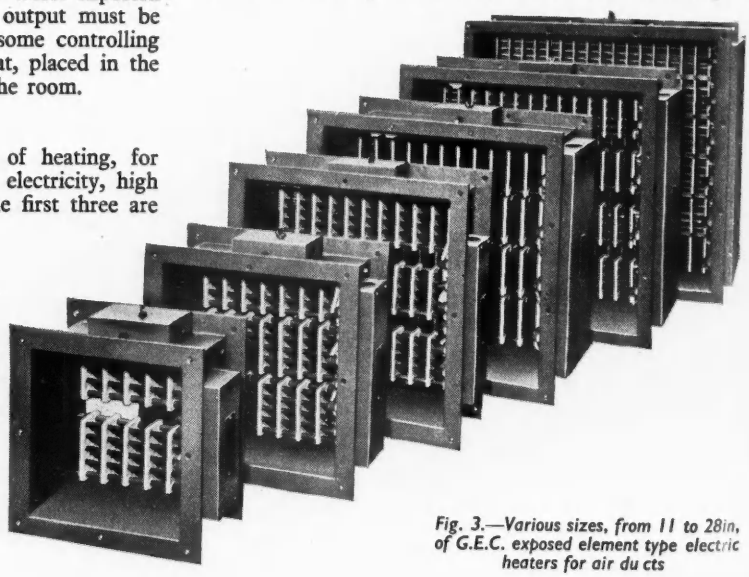
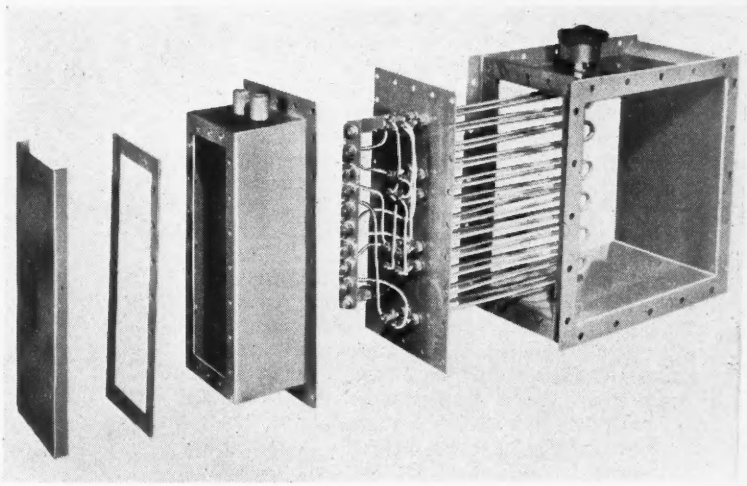


Fig. 3.—Various sizes, from 11 to 28in, of G.E.C. exposed element type electric heaters for air du cts

It is clean to use and easy to fit and maintain. No piping, valves, strainers, traps, etc., are needed and conduit is lighter than piping and suffers from no thermal expansion problems, nor does it need thermal insulation. No separate plant room and boiler are needed or a circulating pump, flues, or fuel storage space. No ash removal is, of course, required and no oxygen is consumed.

Perhaps the most important item amongst these advantages is that no separate heating plant is needed. A plenum ventilating system is bulky in its distribution because of the ductwork which is needed. An air conditioning system is also expensive in plant room space, much ancillary equipment, such as refrigeration machinery, being necessary. Consequently the fact that no further valuable space is needed for the installation of boilers may make the use of electricity for the air heaters most desirable.



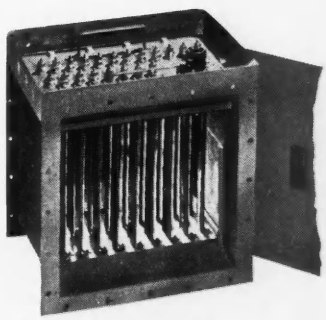


Fig. 4 (right).—An air heater by George Bray using the enclosed type of strip element, and having the terminal box integral with the frame. Fig. 5 (above).—Exploded view of a "Tubalox" unit type heater

Installation

The overall shape of a battery is governed by the fact that it has to be fitted into a system of ventilating ductwork which is invariably rectangular or circular in section. A rectangular battery shape is quite satisfactory for both these sections, since in the case of the circular duct, transformation pieces can be incorporated in the ducting upstream and downstream of the heater. Flanges on the outer casing of the battery are arranged to mate with and bolt to other flanges on the ductwork.

Generally speaking, the duct length containing the battery is horizontal. However, it is possible that on occasion it might be convenient to fit the air heater in a length of vertical duct. In such a case an electric battery would be at a distinct advantage over one using steam where trapping difficulties might arise.

When installing any type of heater in a duct system it is desirable to arrange for an access door in the ductwork, on each side of the battery, for use in fitting and maintenance. It is further advisable in the case of the electric heater to place a large mesh wire guard across the section of the duct a few feet upstream of the battery, removable from the upstream access door. The purpose of this is to counter fire or smoke risk should any rags or other materials find their way into the ventilation system.

It is important to incorporate a safety cut-out thermostat in the battery circuit, arranged to switch off if the temperature rises too much, as would be the case if the fan failed.

Construction

The resistors which comprise the heating elements are in use in either of two forms, exposed or enclosed. The enclosed class is divided into two sub-classes, finned and unfinned.

The air heater using the exposed type of element consists of open spiral wires wound on to porcelain formers which are grouped parallel to one another across the duct to form banks. A battery comprises one or more of these banks. Fig. 3 shows a group of typical exposed element heater batteries.

The enclosed type of element has a resistor which may also be spirally wound, running along the axis of a cylinder or narrow block of material having high thermal conductivity and high electrical resistance, not a very common combination of physical properties. The whole element is encased in a metal sheath which may or may not be finned.

The sheathing material varies from mild steel to stainless steel, via several nickel-chromium and copper-nickel alloys, the material used depending upon the working temperature of the sheath. For most normal ventilation applications this is likely to be relatively low, certainly much less than the temperature of 840 deg F, above which scaling is excessive for mild steel. It is worth noting at this point that the regulations of the London County Council applicable to ventilation and air conditioning for places of public entertainment, prohibit the use of heater batteries where the surface temperature of the elements exceeds 250 deg F. Fig. 4 shows a heater battery in which the elements are enclosed in the form of strips and arranged in two banks. In this particular case it is seen that the elements are not finned. A further type of sheathed wire element may be used. Fig. 5 gives an exploded view of an air heater employing such an element.

I can be seen in both these pictures that the terminals of the resistors are all arranged on one side. This is most convenient for installation, wiring up and maintenance. In the case of batteries using steam as a heating medium it is necessary to have supply pipes and headers at the top, and return or condensate pipes and headers at the bottom.

In using the enclosed type of element one is not confined to stock sizes and shapes. Heaters can be made up to suit particular requirements. Illustrative of this, although it is outside the field of plenum ventilation and

comfort air conditioning, is the installation shown in Fig. 6.

The decision as to which type of element will provide the most satisfactory heater for a particular application can only be made after due consideration has been given to the relative merits of the types involved. In favour of the enclosed type of resistor, it is claimed that it has the greater mechanical strength, it is robust, and not being exposed to the air, corrosion does not occur. Further, it may be bent to any reasonable shape to suit particular applications; thus it is reckoned to be the more flexible and adaptable. Furthermore, there is no risk of electric shock—the live elements are totally enclosed.

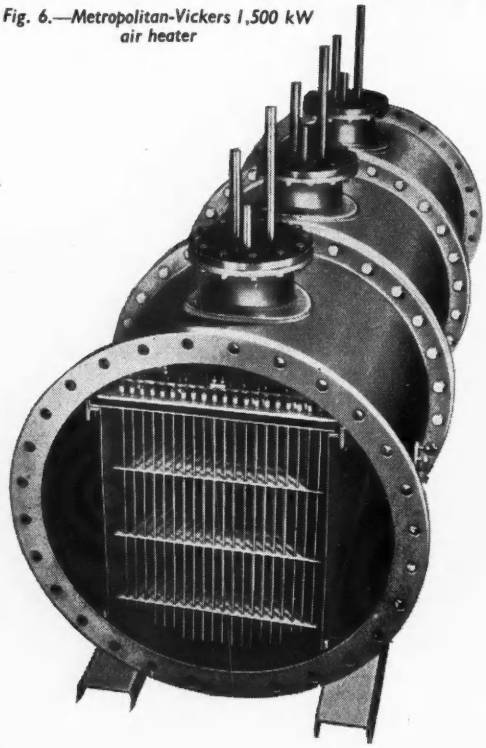
On the other hand, the advocates of the open wire type of element claim that this is a more reliable installation, failure of the enclosed type being attributable to local overheating, due to dust deposition on the sheath surfaces, and to the presence of stagnant areas of low air velocity across the face of the battery. It should be realised that unless special steps are taken, e.g. the fitting of a fine mesh screen upstream of the battery, it is unlikely that a uniform air velocity will prevail across the face area of the heater. A continuous charring away of the dust deposited on the exposed type of resistor occurs; also, because of the absence of any sheathing or refractory material, that is, because of the low thermal capacity of the element, a build-up of temperature in the vicinity of an area of stagnant air is discouraged by the rapid conduction of the surplus heat to the rest of the element.

The risk of dust accumulation and its consequences increases with the use of finned elements. Finning may be adopted in an effort to increase the rating of an element.

As a final comment on this question of dust deposition: nearly all ventilation and air conditioning systems fit air filters as a matter of necessity for the maintenance of reasonable air cleanliness and it follows that the dust deposition tendency will depend upon the pollution of the air taken into the system and the efficacy of the air filter used.

Air conditioning and plenum ventilating systems cover a wide range of heating and cooling loads. As an example of a high duty heater, Fig. 6 shows a battery with a rating of 1,500 kW. Elements are designed to operate at black heat, the working temperature being dependent upon surface temperature, air velocity and application.

Fig. 6.—Metropolitan-Vickers 1,500 kW air heater



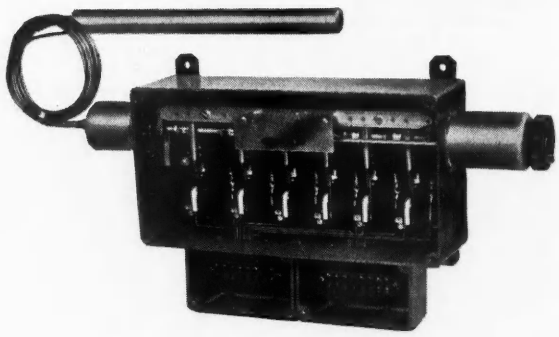


Fig. 7.—Controller suitable for a six step air heater battery by Teddington Industrial Equipment, Ltd.

The life of an element and its continued satisfactory operation depends, amongst other things, upon its working temperature. The open type of element may be used for discharge temperatures up to 150 deg F, and the enclosed type of element may be employed for final air temperatures not exceeding 100 deg F. Plenum ventilating systems seldom need supply air temperatures in excess of 125 deg F and quite often they are of the order of 85 deg F. Thus using electricity imposes no restriction on supply air temperature in common practice.

Control

Three possibilities might be considered for controlling the heat output from an electric heater to an airstream: (a) resistance variation, (b) voltage variation, (c) step control. The first is clearly uneconomical and not worthy of serious consideration and the second is likely to prove expensive. Step control is the method that is widely adopted. Up to six steps are easily obtainable, and more may be used if considered necessary.

A thermostat placed either in the room being conditioned, or in the recirculation air duct, can be arranged to make or break one of the heater steps, usually indirectly by contactors. A popular arrangement is for the response of the thermostat to energise an electric motor. Cams are fitted on a shaft driven by the motor, and these in their rotation operate successive mercury tilt-switches which in turn operate the contactors. The action of the tilt-switches is decisive and not wavering. Such an arrangement enables successive steps to be cut in as required and the output of the battery to be progressively increased, or vice versa.

With another arrangement, adopted for smaller outputs, the thermostat is not part of an electrical circuit. Instead, the temperature sensitive element consists of a metal phial containing a volatile fluid connected by a capillary tube to a flexible bellows. The volatile fluid expands with increase of temperature, inflating the bellows. A rod attached to the bellows moves as the bellows extend, and spring loaded collars on the rod engage and trip in succession a number of switches. These switches make or break the step circuits via contactors. Fig. 7 shows a controller of this type suitable for a six-step battery. The motor operated type mentioned earlier is obtainable for up to twenty steps, and is somewhat more expensive.

One might imagine that controlling temperature by

means of a series of large increases or decreases in the heater output would result in a considerable fluctuation in the room temperature and a fair degree of hunting by the control system. This, however, is not necessarily the case.

If the heat losses from a room are 40,000 B.Th.U./hr, based on a temperature of 65 deg F inside and 30 deg F outside, then the required heater battery output, using 1,000 c.f.m. of fresh air (100 per cent), is likely to be about 80,000 B.Th.U./hr. It is larger than the heat loss since the battery has to heat air from 30 deg F to, say, 100 deg F (assuming that the supply air temperature is 100 deg F), whereas this air, in cooling from 100 deg F to 65 deg F in the room being ventilated, offsets the heat loss of 40,000 B.Th.U./hr.

Suppose that the thermostat has a differential of ±2 deg F. If the outside air temperature rises from 30 deg F to 32 deg F the room temperature rises to 67 deg F (approximately). Let us further suppose that the electric heater has its output subdivided into six steps. The rise in room temperature will then be dealt with by the thermostat switching off the first step. This reduces the heater output in such a way that the temperature of the air leaving the battery (which is in fact the supply air temperature) falls to about 88 deg F. Air supplied at this temperature to the room will maintain there a temperature of about 53 deg F.

The result of the battery reducing its output by closing down one of its steps will be that the air temperature in the room starts to drop from 67 deg F towards 53 deg F. As the temperature reaches 63 deg F the thermostat cuts in again the sixth step of the heater.

The important feature of this cycle of temperature changes is the time which they take. This will depend upon two things: The rate of air change in the room; and the thermal capacity of the structural fabric in the room.

Air change rates in rooms being mechanically ventilated vary from about 3 per hour to as many as 60 per hour.

In the example chosen no recirculated air was being handled. If 50 per cent of the supply air had been recirculated, and the balance made up with fresh air, then the battery output need only have been about 60,000 B.Th.U./hr. The cutting out of one step of the battery would have resulted in a supply temperature of 91 deg F which would tend to produce a slightly higher temperature in the room than the 53 deg F of the other case.

More important is the fact that since the amount of fresh air handled is halved, so is the air change rate, and consequently the time taken for a change in supply air temperature to appear as a significant change in room temperature is doubled.

As regards the second point, if the thermal capacity of the walls of the building is large (high specific heat and density coupled with poor thermal conductivity) it does not allow changes in outside temperature to appear very quickly as changes of temperature inside.

In conclusion it appears that electricity may be a suitable medium for heating in plenum or air-conditioning systems when an advantageous combination of one or more of the following exists: no existing boiler plant; favourable tariffs may be obtained; the thermal capacity of the building is high; the air change rate is small; and the notable advantages of electricity, cleanliness, etc., are of particular importance.

Finally it should be appreciated that ventilation and air conditioning cover a wider field than is discussed in this article, and that certain industrial ventilation schemes may be eminently suitable for the use of electric heating.

Electrical Research

Recent Publications of the E.R.A.

A NUMBER of technical reports have been released for publication recently by the British Electrical and Allied Industries Research Association. Among these is Ref. M/T120, "A Simple and Versatile R.F. Measuring Circuit," by J. Miedzinski and S. F. Pearce (price 10s 6d). The authors show that the impedance-frequency characteristics of components and the transmission characteristics of filters may be determined by means of circuits employing simple apparatus readily available in the laboratory. Impedances from 10^{-2} ohms to 10^{6} ohms and the insertion loss of filters up to about 120 dB can be measured over a frequency range of 150 kc/s to 150 Mc/s. Results are obtainable to an accuracy of one or two per cent if reasonable precautions are taken.

The methods described were found useful in connection with the development of components for radio-interference suppression and avoided the need for more elaborate equipment. A feature is the ease with which the effect of power frequency or direct polarising currents on ferro-magnetic-cored inductors can be determined.

Impregnated Paper Capacitors

Ref. L/T327, "Stabilisation of Impregnated-Paper Capacitors: Further Pilot Scale Tests with Azobenzene," by H. F. Church (price 15s), is an extension of an earlier report, Ref. L/T268, describing life tests on stabilised impregnated-paper capacitors which had been made industrially under pilot scale conditions. Two per cent of azobenzene in chlornaphthalene impregnated capacitors is found to cause a considerable extension of life under d.c. stress at 50, 71 and 85 deg C. Under some conditions the extension of life was up to 50 times.

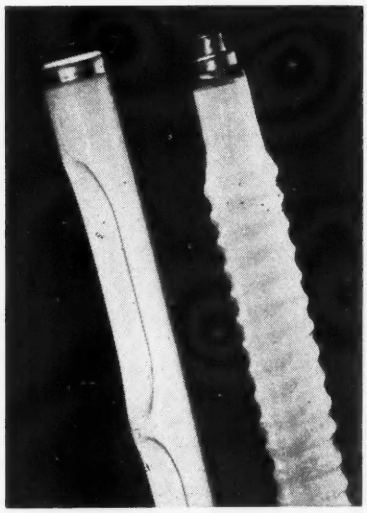
Five per cent of azobenzene in chlornaphthalene is even more effective than 2 per cent. Some stabilisation under d.c. stress is also observed with azobenzene in petroleum jelly impregnated capacitors. Under sufficiently high a.c. stress (50 c/s) very marked stabilisation is observed with both 2 and 5 per cent azobenzene in chlornaphthalene impregnated capacitors. This is partly an indirect effect arising from the action of azobenzene in raising discharge inception voltage.

Pole-Face Losses

The losses occurring in the pole-face, solid or laminated, owing to open or semi-closed slots on the armature surface can be resolved into two components: (1) the losses due to eddy currents and (2) the losses due to hysteresis. There are of course additional losses caused by pulsations in the main magnetic circuit. Numerous attempts have been made since the beginning of the century to determine these losses, both theoretically and experimentally. A brief account is given in Ref. Z/T98, "Pole-Face Losses in Rotating Electrical Machinery. A Review of the State of the Art," by K. C. Mukherji (price 15s), of the more important investigations, with critical comments on the methods employed and the results achieved.

Luminescence

FLEMING MEMORIAL LECTURE



Experimental high-loaded fluorescent tubes showing the "kidney-shape" design developed in the U.S.A. and the corrugated construction evolved at the G.E.C. Research Laboratories

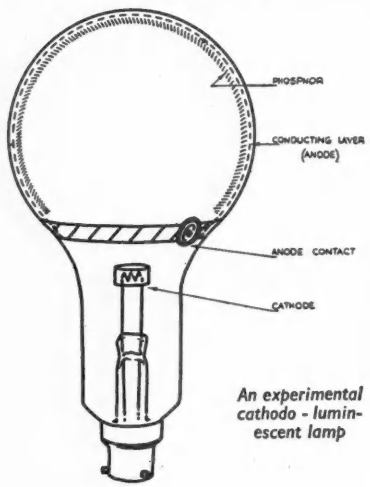
NEW high power fluorescent tubes and colour-corrected high-pressure mercury vapour lamps were among the latest developments demonstrated by Mr. H. G. Jenkins (General Electric Co., Ltd.) when he presented the Fleming Memorial Lecture to the Television Society in London last week. He described the various ways in which luminescence may be excited in materials, and gave examples of new developments in phosphors and new applications of the phenomenon of luminescence.

After defining luminescence as the property of emitting light when excited by h.v. radiation or electrons, the various types of luminescence were described. In addition to photo-luminescence, and cathodo-luminescence, the speaker referred to tribo-luminescence excited by frictional energy, and electro-luminescence in which the phosphor was excited by an electric field.

An account of modern interpretations of the nature of luminescent radiation was followed by a description of the techniques used in preparing luminescent materials. The quantum efficiency of phosphors used in fluorescent tubes was now close to its theoretical maximum. Development work was now being aimed at producing a more concentrated light source by increasing the power dissipation per unit length of the discharge. Until recently the British 5ft 80 W lamp was the most heavily loaded in the world. Increasing the loading produced a rise in temperature and mercury vapour pressure, resulting in lower efficiency.

By making the tube kidney-shaped or ellipsoidal in section over most of its length, however, a lower concentration of positive ions could be achieved, with a corresponding increase in the electron energy. This process was helped by reducing the filling pressure of the carrier gas, argon, enabling increased electrical loading to be achieved with good initial efficiency. In Great Britain and the United States 4ft 100 W lamps had been developed along these lines.

An alternative approach was to use a conventional circular section envelope with the ends of the tube operating at 10 deg C lower than the central parts. This resulted in a reduction in vapour pressure, and by using neon instead of argon as the carrier gas, the tube voltage was kept high and the necessary power dissipation could be secured without the need for high current densities.



An experimental cathodo-luminescent lamp

High-pressure mercury lamps had much higher loadings than fluorescent tubes, and the emitted radiation tended to be distributed in the long-wave u.v. and visible regions, in contrast to the mainly short-wave u.v. radiation from the low-pressure mercury discharge. The deficiencies in the radiation from the high-pressure discharge were mainly at the red end of the spectrum and the recently developed, red-emitting phosphors, excited by the long-wave u.v. radiation, enabled substantial improvements in colour-rendering properties to be achieved.

Development work was in progress at Wembley to secure even better colour-rendering properties from these fluorescent mercury lamps and experimental types, rated at 400 W, were demonstrated with colour-rendering properties equal to those of the best low pressure fluorescent tubes.

The cathodo-luminescent process used for television tubes was intrinsically efficient in producing light. An experimental cathodo-luminescent lamp was demonstrated using a conventional bulb and giving white light. The luminous efficiency was less than that of a normal tungsten filament lamp and much work remained to be done. Turning to electro-luminescent panels, Mr. Jenkins said that their efficiency was poor and considerable improvements were necessary before they could be regarded as important light sources, although they were finding applications in instrument lighting, indicators and in the photographic industry. The ability to control their light by an electric field suggested other potentially important applications in the field of light or image amplifiers.

Careers in the Telecommunication Industry

A new booklet outlining the various careers associated with the above mentioned industry has just been published by the Telecommunication Engineering and Manufacturing Association. The industry has establishments in many parts of the country; information concerning these establishments can be obtained from youth employment officers or careers advisory officers.

The booklet describes the kind of job available and what its requirements are, also types of equipment manufactured and how people are trained.

Information can be obtained from the offices of the Telecommunication Engineering and Manufacturing Association, Stafford House, 40-43, Norfolk Street, London, W.C.2.

ELECTRICAL TRADE OF AUSTRALIA

United Kingdom Still Principal Supplier

AUSTRALIA'S electrical trade, shown in the tables below, increased both in exports and imports during the Commonwealth financial year to 30th June last. Imports, in spite of many restrictions, rose by 24 per cent and her exports by 19 per cent. Among her trade partners by far the most important is the United Kingdom, which supplied about 78 per cent of Australia's total electrical requirements, ranging from heavy power plant to "miniaturised" electronic equipment. (£A1·25=£1 sterling.)

PRINCIPAL ELECTRICAL IMPORTS (£A)

Product	Year ended 30th June, 1955	Year ended 30th June, 1956
Power boilers	821,150	988,696
Steam turbines	386,013	249,951
,, ,, parts	1,790,121	1,891,067
Water turbines	1,997	2,567
,, ,, parts	459,979	793,015
A.c. generating units	461,654	86,908
D.c. ,, ,,	403,134	174,839
Turbo- and hydro-alternators	987,109	2,114,628
Other alternators	265,905	258,463
D.c. generators	133,145	427,230
Motors, under 1 h.p.	1,309,083	1,098,992
,, above 1 h.p.	1,430,877	1,781,497
,, traction, d.c.	80,533	364,718
,, d.c., n.e.s.	302,485	276,756
Convertors	6,902	12,184
Dynamo-electric machines, n.e.s.	26,411	35,871
Induction coils	30,252	82,366
Voltage regulators	233,675	284,053
Transformers, under 12,750 kVA up to 66 kV	370,298	338,712
Ditto, 12,750–15,000 kVA	6,524	6,618
Ditto, exceeding 15,000 kVA	11,029	145,197
Ditto, 66 kV up to 12,750 kVA	8,351	5,294
Ditto, 66 kV exceeding 12,750 kVA	209,906	332,053
Ditto, above 66 kV	1,244,543	1,624,879
Current rectifiers	768,385	834,017
Circuit breakers and switch units	1,469,043	1,472,611
Slip regulators, thrustors and time switches	443,084	421,477
Switches, n.e.s.	1,010,091	1,134,399
Vacuum tubes	92,966	286,135
Cut-out, and chokes	99,555	63,299
Regulating, starting and controlling apparatus, including distribution equipment and switchboards	1,930,796	2,140,483
Protective equipment	272,835	425,093
Lightning arrestors	138,520	200,130
Current limiting reactors	33,624	35,679
Relays (protective)	297,208	447,674
Capacitors	114,430	166,050
Lighting accessories	67,922	109,032
Dry batteries	44,400	68,282
,, ,, parts	75,839	24,650
Wet batteries	38,958	34,502
Vehicle accumulators	80,318	6,623
Storage batteries	54,688	132,720
Other batteries	47,677	24,967
Battery parts	52,706	96,185
Vehicle dynamos	285,421	305,635
Starter motors	422,563	422,424
Magnetos and dynamo-magnetos	188,571	351,578
H.t. distributors	240,782	257,146
Ignition coils	79,205	63,448
Fans	160,248	189,795
Household refrigerators	242,115	51,394
Other refrigerators	28,617	54,839
Refrigerator parts	921,517	773,683
Refrigeration apparatus	8,047	4,104
,, ,, parts	42,239	41,750
Washing machines and wringers	1,111,638	632,851
Washing machines, n.e.s.	81,055	71,806
Household ironing machines	954	151
Dish washers	25,597	19,807
Floor polishers	720,902	476,936
Vacuum cleaners	551,379	285,612
,, ,, parts	60,493	53,832
Ranges 2·4–15 kW	585,390	304,720
Cookers	66,037	70,845
Heating units and parts	132,544	232,411
Radiators, toasters and kettles	142,074	79,508
Other heating and cooking appliances	211,309	211,612
Flat irons	262,864	209,533
Welding equipment	70,858	62,872
Measuring and recording instruments	827,500	1,490,491
Insulating tubes	45,790	51,588
Projector and arc lamp carbons	72,591	131,423
Carbon furnace electrodes	140,996	188,123
,, blocks, plates, slabs, etc.	158,595	153,073
,, brushes	48,636	33,182
Other brushes	23,153	49,715
Cables, wires and copper strips	1,847,256	1,904,745
Radio receivers	285,172	236,018
,, transmitting equipment	325,492	346,129
,, components	408,890	743,315
,, valves	480,243	700,669
Telegraph apparatus	53,360	29,764
Telephone apparatus and parts	1,069,397	1,331,306
,, distribution boards	94,963	7,898
,, switchboards, automatic	203,518	877,527
,, ,, manual	138,372	220,297
Telegraph and telephone apparatus, n.e.s.	693,175	1,748,705
Appliances, n.e.s.	1,663,469	2,362,233

ELECTRICAL EXPORTS (£A)

Product	Year ended 30th June, 1955	Year ended 30th June, 1956
Power boiler and parts	11,660	53,264
Turbines and parts	4,011	60,151
Motors and parts	74,217	49,986
Generators	292,311	180,946
Transformers and rectifiers	41,944	89,968
Regulating, starting and controlling apparatus	139,652	174,823
Protective equipment	21,618	20,501
Fans and parts	26,406	22,659
Domestic appliances	59,384	66,206
Electro-medical apparatus	406,808	383,344
Telephone and telegraph equipment	45,715	177,657
Radio receivers	69,601	101,081
,, transmitters and parts	214,778	461,613
,, receiver components	296,896	240,404
,, valves	67,487	54,791
Ignition equipment	28,918	22,715
Traction equipment	27,064	5,439
Filament lamps and arc lamps	40,916	11,009
Other lamps	23,826	28,428
Batteries, accumulators and parts	453,531	456,648
Fittings and wiring devices	92,083	101,214
Miscellaneous apparatus	220,774	192,803
Wires and cables	160,473	360,805

CHIEF SOURCES OF SUPPLY AND MARKETS (£A 000)

Country	Year ended 30th June, 1955		Year ended 30th June, 1956	
	Imports from	Exports to	Imports from	Exports to
United Kingdom	22,649	138	27,808	107
United States	1,998	47	3,253	15
W. Germany	1,437	4	926	3
Holland	614	—	1,135	—
Canada	542	—	284	—
New Zealand	—	781	—	943
Singapore	—	219	—	159
Total including other countries	28,719	2,326	35,520	2,740

Insulating Papers

BECAUSE of the urgent need in 1936 for a British Standard dealing with insulating papers, the first edition of B.S. 698 was published without waiting for the results of some experimental work which was then being done by the British Electrical and Allied Industries Research Association. This work was interrupted by the war, but has since been completed, and the British Standard has now been revised in the light of the conclusions reached, and of a further study of the needs of the electrical industry.

The requirements of the new edition are generally similar to those of B.S. 698: 1936, but many changes in detail have been made and the opportunity has been taken to adopt wherever possible methods of test recommended by the British Paper and Board Manufacturers' Association.

The standard deals with a wide variety of papers, and for some properties it is necessary for the purchaser to state his requirements within the range specified in the standard. Appendices deal with the conditioning of specimens for test, and the determination of properties and characteristics. A method for carrying out tests for conducting paths in capacitor tissue paper is described and details are given of a suitable oven for ageing paper. Copies of B.S. 698: 1956 may be obtained from the British Standards Institution, 2, Park Street, London, W.1, price 7s 6d.

Transistor Applications

Discussion on Three I.E.E. Papers

AT the meeting of the I.E.E. Radio and Telecommunications Section on 23rd January the discussion on the three papers on transistors (see *Electrical Review*, 25th January, p. 144) was opened by Mr. T. R. Scott (Standard Telephones), who said that the paper by Nambiar and Boothroyd brought out very clearly some of the advantages of the transistor. The authors, however, seemed to suspect that there were not yet in Britain transistors capable of operating at sufficiently high frequency. In a couple of months or so this was likely to be remedied.

Mr. E. H. Cooke-Yarborough (A.E.R.E.) said that the "bootstrap" circuit (Nambiar and Boothroyd) had the disadvantage of requiring what amounted to a floating battery. The problem of restoring the charge was repeatedly mentioned in the paper, whereas in the Miller circuit this difficulty was avoided. It should be possible to scale down the currents in the bootstrap circuit, considerably increasing the input resistance of the emitter-followers.

Mr. J. I. Carasso (Post Office) said that the Materials Division of the P.O. Research Station had examined the possibilities of developing a fast germanium junction diode of the thick-base, short-lifetime type by the indium alloy technique but using indium doctored with nickel. By firing their assemblies at 700 deg C, diodes of satisfactory characteristics had been made in which enough nickel was diffused to reduce the hole lifetime to about 0·1 microsec at low injection levels. At relatively modest injection levels the effective lifetime began to rise. His colleague Mr. G. T. Hollins found that the effect should set in at a forward current density of 0·1 A/cm^2 (to which the current density must be kept down) with a resistivity of 1 ohm-cm. Most applications required a forward current rating of at least 1 milliamp, which entailed an area of 1 mm^2 or more. In a diode of that size with a lifetime of 0·1 microsec the depletion layer capacitance caused a longer time-lag than the hole-storage effect. For most circuits optimum performance should be obtained by operating the diode at about 2 A/cm^2. The effective lifetime in the fastest diodes they had made was 0·3 microsec or more, well above the low-level value. If the concentration of nickel in the germanium could be further increased there should be a net gain in speed of response.

Temperature and Leakage Currents

Dr. G. B. B. Chaplin, discussing the circuit in Fig. 11 of the paper by Nambiar and Boothroyd, said that if the temperature was increased the leakage currents increased tremendously. It was difficult to know what temperatures were reached, but 50 deg C might be a reasonable maximum for operation indoors, and at this temperature the leakage current of an audio-frequency transistor could increase to about 150 microamps and of a point-contact diode to about 50 microamps. Increase of temperature would also affect the sweep linearity, and an increase to 50 deg would alter the emitter base potentials of the transistors by about 100 millivolts, which with the surface barrier transistor would represent about 3 per cent of the total sweep voltage. These were large changes compared with the accuracy of the sweep.

Mr. L. P. Morgan said that Mr. Oakes had not said much about Class C operation, but some experiments they had done indicated that in Class C operation at relatively low frequencies high efficiencies could be obtained with a sinusoidal oscillator. They had developed a diode which successfully used the technique of nickel doping. There was need for a small free storage diode giving low hole storage of 300 to 400 milliamps.

Mr. B. Dale said that by sand-blasting the germanium surface, a surface recombination velocity as high as 10^5 cm/sec was obtainable, which indicated an admirable method of producing a low-hole storage diode, particularly as a narrow-base structure gave a very low flow resistance and therefore a very high flow current at quite low voltage. With silicon the problem was not so simple, because the surface recombination velocity remained remarkably constant under different surface treatments and sand-blasting was not so beneficial.

Opportunities for Graduates

DURING the next few days 20,000 undergraduates in their last year at all the universities and colleges in the country will be receiving a copy of the 159-page book "Directory of Opportunities for Graduates." This directory, to which Lord Chandos has written a preface, gives details of the careers offered by nearly 200 organisations which recruit graduates on a large scale. The purpose of the book is to provide final-year students with a clear and comprehensive picture of the openings available to them, particularly in industry where there are so many opportunities, by collating information in a standard form. Each entry in the reference section gives details about the company, its products or activities, the types of graduates required, the work involved, the training and salaries offered, and the places of employment.

In the preface Lord Chandos points out that the book is complementary to the work of the University Appointments Boards, many of whom have co-operated in its compilation and distribution. The directory is published by the Cornmarket Press, Ltd., 1, Lower James Street, London, W.1, of which the directors are two 25-year-old Oxford graduates, Mr. C. Labovitch and Mr. M. Kavanagh. They have been assisted by an Editorial Advisory Board consisting of Mr. C. E. Escritt, secretary of the Oxford University Appointments Committee, Mr. E. D. Foster, editor of *The Director*, and Mr. R. W. Pennock, staff manager of the I.C.I. at Billingham.

Copies of the directory are free to all final-year students at universities and colleges but can be obtained by others price 7s 6d through the usual channels.

World Power Statistics

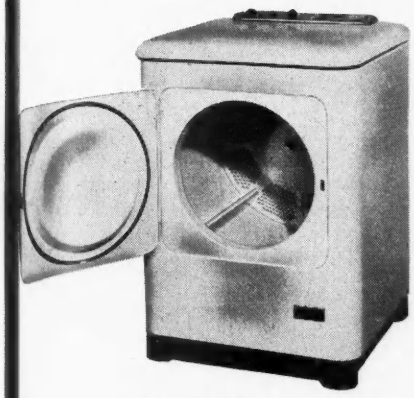
The eighth edition of the Statistical Year Book of the World Power Conference (edited by Frederick Brown) has now been issued (£3 3s; Percy Lund, Humphries & Co., Ltd., 12, Bedford Square, London, W.C.1). Its 176 pages contain data on resources, production, stocks, imports, exports and consumption of power in 1952-54 and in some instances in 1955 for all countries from which statistics were procurable. Some of the figures relating to earlier years have been revised in the light of recent information.

NEW ELECTRICAL EQUIPMENT

Tumbler Dryer

The "Auto-Dry" domestic electric tumbler dryer is the latest addition to the range of laundry appliances manufactured by PARNALL (YATE), LTD., 255, North Circular Road, London, N.W.10. It is designed to fit under the draining board, measuring only 29in high by 20½in square, and it has a capacity of 5½ lb of dry clothes. An automatic timer, in conjunction with a three-heat switch, enables the user to select the correct drying time for any fabric.

Air is drawn over a 2½ kW element by a fan and the heated air ensures rapid drying as it flows through the steel drum. A ⅛ h.p. motor operates

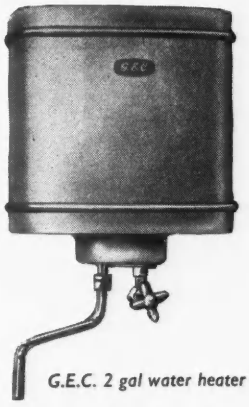


Parnall (Yate) "Auto-Dry" tumbler dryer

the drum and fan by means of a belt drive. The speed of the drum is 45 r.p.m. An automatic door cut-out switch disconnects the heater and stops the drum revolving when the door is opened. The cabinet is of rust-protected sheet steel finished in white or cream stoved enamel, and the total weight of the machine, which is mounted on castors, is 116 lb. The price is £36 4s 2d plus £16 5s 10d purchase tax in the United Kingdom.

Water Heater

A 2-gal water heater, designed to keep service costs down, has been announced by the GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London, W.C.2. Easier wall fixing is achieved by a fixing bar, supplied with every heater, which is screwed on the wall and the heater hung on it. Plumbing costs are also cut as there is only one union connector (supplied with the heater) which enables direct connection to be made with copper, lead or steel pipe. The heater can be



G.E.C. 2 gal water heater

connected to either the water mains or cold water tank.

The sheathed wire heating elements (total loading 1·2 kW) are easily removed and the full-length rod thermostat can be adjusted easily to give the required temperature of hot water. The removable apparatus plate covers a full size hand-hole to give access for cleaning all internal parts. The heater has a rustless aluminium outer case and a completely sealed tinned copper inner container.

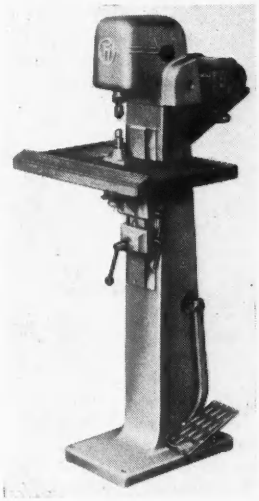
Of attractive modern design, it is supplied in two colours, white or honeysuckle, with fern grey coloured decorative bands. The tap and spout are chromium plated. The price is £12 7s 6d plus £5 15s 10d purchase tax in the United Kingdom.

Automatic Riveting Machine

The German firm of Thielicke & Co., Karlsruhe, who are represented in this country by F. J. PISTOL, LTD., 248, Watford Way, London, N.W.4, have recently introduced a precision riveting machine. It is claimed that rivet heads can be formed within limits of ±0·0005in.

The machine is driven by a ⅓ h.p. motor and V-belts. Depressing the foot pedal engages the friction clutch

Precision riveting machine



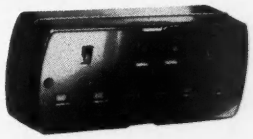
and lifts a plunger in the centre of the table. The upper end of this plunger carries the exchangeable anvil insert. The head is formed by raising the rivet shank against the hammering and rotating punch. The riveting hammer gives 3,500 blows/min; maximum rivet diameter, steel, 0·080in, throat standard 3in. A variety of riveting tools are available.

The machine has been primarily designed for such delicate operations as the riveting of electrical contacts, instrument work, clock work, cameras, office machinery parts, etc. The machine is sufficiently sensitive to allow the riveting of brittle materials such as glass, ceramics, Bakelite, etc.

Twin 13 A Switch-sockets

A new range of twin 13 A switch-sockets is now being produced by M.K. ELECTRIC, LTD., Wakefield Street, Edmonton, London, N.18. In addition to both surface and flush all-insulated patterns in brown or ivory the company is also manufacturing a surface metalclad unit and a flush unit with brass plate finished BMA or matt chrome.

The use of permanent interconnec-

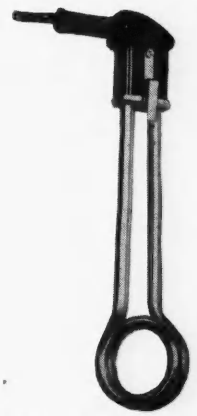


M.K. Electric surface pattern twin 13 A switch-socket

tions between the two socket-outlets means that only one set of terminals is required so that the twin unit is as quick and easy to install as an ordinary single switch-socket.

Portable Immersion Heater

The "El-Boilo" portable immersion heater introduced by L. G. HAWKINS & CO., LTD., 30-35, Drury Lane, London, W.C.2, has been designed for boiling water for hot drinks, heating milk, etc. It is also claimed to be suitable for cooking potatoes and other vegetables as well as for sterilising purposes. The appliance has an overall length of 9in and the coiled heater tube is chromium plated. The loading is 700 W. A spring clip in the head of the heater enables it to be hung over the side of a vessel or saucepan. It is provided with 4ft of 3-core flexible. The price is £1 0s 6d plus 9s purchase tax in the United Kingdom.



L. G. Hawkins "El-Boilo" portable immersion heater

GENERATION AND DEVELOPMENT

Overhead Line Inquiry

A public inquiry was held on 24th January into a dispute between the North Western Electricity Board and Hazel Grove and Bramhall Council concerning the Board's proposal to erect an overhead line across a green belt in order to supply new housing development. Mr. F. E. Capper, clerk to the Council, said that the Board was far more concerned about how much it would save, rather than how much a beautiful landscape would be spoiled by poles and wires. Mr. Geach, representing the Board, said an underground cable would cost about £4,000 compared with only £1,800 for an overhead line.

Power Tariffs and the "Price Freeze"

The South Western Electricity Consultative Council has made representations to the Board on behalf of industrial and commercial consumers who have been paying for the higher cost of coal while the prices to other consumers have been stabilised since last June under the "price freeze." The Board has agreed to take this into account in its present review of tariffs and to discuss the principle with the Central Electricity Authority.

Distribution Extensions in North East

At the quarterly meeting of the North Eastern Electricity Consultative Council at Newcastle-on-Tyne it was reported by the Electricity Board that during September, October and November 261 new substations had been put into operation and high voltage supplies had been taken to 22 industrial and commercial consumers. During the same period 170 miles of cables and mains were laid, and electricity supplied to 344 agricultural premises. In addition, negotiations were completed for supplying another 309 agricultural premises. The Board has approved further development plans to cost £1,186,438, including schemes for 81 housing projects and 151 rural supply schemes.

Durham R.D.C. has approved a proposal by the Board for the erection of a low voltage overhead line in connection with the reinforcement of the network at Bearpark formerly owned by the Coal Board.

Ryton (Co. Durham) U.D.C. is asking the Electricity Board to supply power to new housing estates by underground cables instead of overhead lines.

Electricity Sales in December

The sales of the twelve Electricity Boards are set out in the accompanying table. The national figures show an increase over December, 1955, of 4·2 per cent, but when corrected for weather conditions and working days the increase is 6·5 per cent.

ELECTRICITY SENT OUT BY AREA BOARDS FOR THEIR CONSUMERS

Area Board	Totals for December (million kWh)			Twelve Months Totals Ended 31st December (million kWh)		
	1955	1956	Inc. or Dec. %	1955	1956	Inc. or Dec. %
London	687·5	723·2	+5·2	6,528·0	7,053·1	+ 8·0
South Eastern	425·0	454·0	+6·8	4,013·5	4,508·7	+12·3
Southern	502·9	545·9	+8·6	4,829·5	5,450·9	+12·9
South Western	251·4	265·3	+5·5	2,484·0	2,765·9	+11·3
Eastern	668·6	717·3	+7·3	6,432·1	7,167·9	+11·4
East Midlands*	557·6	579·9	+4·0	5,610·8	6,078·6	+ 8·3
Midlands*	730·9	740·1	+1·3	7,398·1	7,806·0	+ 5·5
South Wales*	396·2	403·5	+1·8	4,296·4	4,518·0	+ 5·2
Merseyside and N. Wales*	438·4	454·1	+3·6	4,415·5	4,781·8	+ 8·3
Yorkshire*	719·9	745·3	+3·5	7,287·9	7,876·3	+ 8·1
North Eastern*	411·9	430·3	+4·5	4,201·4	4,533·9	+ 7·9
North Western*	781·2	781·1	0·0	7,825·2	8,277·1	+ 5·8
Total all Area Boards	6,571·5	6,840·0	+4·1	65,322·4	70,818·2	+ 8·4
Direct Supplies by Central Authority	177·8	190·8	+7·3	1,870·1	2,162·9	+15·7
Grand Total	6,749·3	7,030·8	+4·2	67,192·5	72,981·1	+ 8·6
Mainly Industrial Areas*	4,036·1	4,134·3	+2·4	41,035·3	43,871·7	+ 6·9
Mainly Non-Industrial Areas	2,535·4	2,705·7	+6·7	24,287·1	26,946·5	+10·9

* Those in which industrial consumers took over 50 per cent of the total sales in the preceding financial year.

Future of Pinkston Power Station

A special sub-committee of Glasgow City Council has proposed that "without committing the Corporation in any way at this stage" the town clerk, city chamberlain and transport manager should discuss with the South of Scotland Electricity Board the terms and conditions on which the Pinkston power station could be transferred to the Board. The station supplies power for the municipal tramways, trolleybuses and underground railway services. In recent years some £2·5 million has been spent on converting the generating plant to the standard frequency.

Rural Electrification Progress

A record number of farms (1,213) have been connected to the public electricity supply in the South West during the first nine months of the current financial year. In addition, supplies have been afforded to a further 5,096 cottages and other rural premises. By the end of March the South Western Electricity Board's five-year programme to connect 5,000 farms and 24,000 other rural premises will have been exceeded in only four years—more than a whole year's work having been gained notwithstanding the restrictions on capital expenditure. The number of crop and grain dryers in the Area has increased from 19 in 1951 to nearly 250 to-day.

The Board has expressed appreciation of the help given by the Consultative Council, particularly through the Joint Rural Development Committees which are sponsored by the Council. These Committees are carrying out excellent work in encouraging farmers and other country people to join in schemes when the supply mains are being extended in their localities, and under the ægis of the Council meetings have been held to show farmers how to make the best use of electricity to cut their costs of labour and fuel.

Houses Wired but No Supply

The North Eastern Electricity Consultative Council is to ask the Electricity Board to consider the position of people in the Gateshead area who, under the impression that electricity would soon be available, had had their houses wired and the gas fittings removed.

It was stated at a meeting of the Consultative Council that the contractors who had wired the houses had no authority to state that electricity would soon be supplied to the area. Mr. W. S. Hall, chairman, said that the position was made worse as the houses concerned were in an area still using d.c. The supply was to be converted to a.c. and, subject to capital being available, the work was expected to start in 1958. It was pointed out that some of the houses had already been wired for two years and were using candles as a temporary measure.

Mr. Hall said he would ask the Electricity Board to consider the possibility of making a temporary d.c. supply available until the area had been changed over to a.c.

Electricity Accounts

With the introduction of the most up-to-date electronic system of billing, the South Western Board has now found it possible to meet the Consultative Council's request to give more information on accounts without

incurring additional cost. This information includes the number of kWh consumed at each price in the block tariff. Members of the Council are shortly to visit the Board's central billing office at Plymouth to see at first hand the latest electronic methods in an installation which is claimed to be the first one of its kind in the country.

Capital Contributions by Farmers

Protests against two farmers in Yorkshire being asked to pay amounts of £490 and £704 towards the cost of supplying electricity to their farms were made at a meeting of the North Eastern Electricity Consultative Council at Newcastle-on-Tyne. It was declared that while the two farmers concerned had been asked to pay these sums towards the cost of the scheme, other farmers living nearby, who were in the area of the Yorkshire Electricity Board, were not asked to pay anything towards the cost of supplying their farms provided they gave an undertaking to use at least £30 worth of power each year for five years.

Mr. W. S. Hall, chairman of the Consultative Council, said that each Electricity Board was self-contained and administered distribution in its area in a manner which would balance costs. The North Eastern Board had large tracts of farm land in its area, and the high connection costs of these areas were not offset as was the case in the area of the Yorkshire Board, where extensive industrial areas helped to meet costs in agricultural districts. This was the reason why the Yorkshire Board could offer the terms it did to farmers. Although it might seem to be unfair that farmers in the Yorkshire area had better terms, nothing could be done about it. Mr. Hall stated that the total cost of supplying the two farms concerned in the matter would be £1,944, and the farmers had been asked to pay, between them, £1,194 towards the cost.

Resale of Electricity

The Midlands Electricity Consultative Council at its meeting in Birmingham on 21st January decided to press the Minister of Power to include in the Electricity Bill legislation to control the maximum price at which electricity may be resold by one consumer to another.

Councillor G. T. Baldwin (Malvern U.D.C.), moving the resolution, recalled that many of the complaints dealt with by the Council concerned alleged overcharging by landlords to people living in flats or on caravan sites. The Council had sent a similar resolution to the Midlands Electricity Board in April, 1952, but the Board had been unable to do anything about it.

Formula Accepted

Middlesbrough Town Council has agreed to terms put forward by the North Eastern Electricity Board for supplying electricity to new housing estates. The Board would not accept the Council's suggestion that points for electric cookers should be installed only at the request of the tenants, and stated that unless the Council agreed to the formula which had been accepted generally throughout the area it would have to charge the Council about £9 a house for supplying electricity to the estate. As this was more than the cost of installing a cooker circuit, the Council agreed to accept the Board's formula.

OVERSEAS

Plans for Finnish Atomic Station

It is reported from Helsinki that plans to electrify the main Finnish railway lines include the construction of an atomic power station. Britain and the U.S.A. have already submitted offers to build such a station.

Ceylon Hydro-Electric Scheme

The Minister of Transport of Ceylon, Mr. M. Senanayake, has announced that preliminary work is to go ahead on stage IIB of the Laxapana hydro-electric scheme. Expenditure of Rs.200,000 has been authorised by Parliament on the preparation of detailed estimates so that tenders may be called. The World Bank has written to the Government asking for details before considering the question of a loan.

Nuclear Power in South Africa

The South African Government has appointed a commission to inquire into the application of nuclear power. It is to investigate the desirability of establishing a nuclear power station in the Western Cape and in other areas remote from the country's large coalfields.

Transport in Colombo

The Mayor of Colombo has been told that the Government will exclude the transport services of the Municipal Council from the Nationalisation Bill which seeks to nationalise transport services in the island. The Council has placed an order for 26 trolleybuses, ten of which are due to arrive shortly.

Generating Plant Installed in 1956

In the *Electrical Review* of 11th January we presented the annual statement by the Central Electricity Authority relating to the generating plant brought into commission during the previous year. We are now able to give similar information for the South of Scotland Electricity Board and the North of Scotland Hydro-Electric Board.

SOUTH OF SCOTLAND ELECTRICITY BOARD

Station	Turbo-Generator Plant		Boiler Plant		Main H.P. Pipework
	Installed Capacity MW	Maker	Capacity k.lb./hr	Maker	Maker
Dalmarnock	1×60	C. A. Parsons	3×200	Yarrow	Stewart & Lloyds
Barony	1×30	General Electric Co.	2×150	Babcock & Wilcox	Babcock & Wilcox
Portobello	1×60	Richardsons Westgarth	1×540	International Combustion	Aiton

NORTH OF SCOTLAND HYDRO-ELECTRIC BOARD

Station	Turbo-Generator Plant	
	Installed Capacity MW	Makers
Achanalt	1×2·4	Turbine by Harland Engineering Co.
Ceannacroc	1×16 1×4	Turbo-alternators by Harland Engineering Co.
Errochty	2×25	Turbine by John Brown & Co.; alternators by General Electric Co.
Invergarry	1×20	Turbo-alternator by English Electric Co., and Harland Engineering Co.
Kilmelfort	1×2·165	Turbine by Gilbert Gilkes & Gordon; alternator by Bruce Peebles & Co.
Lerwick	1×2	Diesel engine by Mirrlees, Bickerton & Day; alternator by Bruce Peebles & Co.
Storr Lochs	1×0·95	Turbine by Gilbert Gilkes & Gordon; alternator by Harland Engineering Co.
Allt-na-Lairige	1×6	Turbo-generator by Harland Engineering Co.
Kirkwall	1×2	Diesel set by Mirrlees, Bickerton & Day; alternator by Bruce Peebles & Co.

Financial Section

STOCKS and SHARES

GOVERNMENT stocks have continued during the past week to make most of the running in the Stock Exchange. The conviction of a coming cut in Bank Rate, sooner or later, kept gilt-edged prices moving steadily upwards. Quotations for the British Electricity stocks and other issues with medium to long redemption dates reached a level four or five points above that ruling at the beginning of the month. Further improvements among leading ordinary shares in the industrial market were credited largely to the gilt edged influence: by the beginning of this week prices had, on the average, recovered the whole of the damage inflicted by the Suez crisis during the second half of last year. Shares associated with the general branches of the electrical industry remained well in favour.

" Atomic " Shares

Shares of the companies which form the five principal atomic power groups paused for a period of consolidation, which was hardly unexpected in view of the rate and extent of the previous rise. This table shows the size of the recovery established since the November depression by some of the shares concerned:—

	Price		
	Nov.	Jan.	Rise
A.E.I.	58/9	68/9	10/-
John Thompson ..	26/3	35/6	9/3
English Electric ..	45/-	52/6	7/6
Babcock & Wilcox ..	68/9	80/9	12/-
G.E.C.	41/3	56/3	15/-
Simon-Carves ..	23/3	29/6	6/3
Crompton Parkinson	13/-	17/6	4/6
Richardsons Westgarth	15/-	18/-	3/-
International Combustion	18/9	22/3	3/6
Head Wrightson ..	102/6	125/-	22/6

Parsons & Reyrolle

In the period covered by the above table, C. A. Parsons and A. Reyrolle made substantial " rights " issues of new shares, and the former distributed also a one-for-two scrip issue. In both cases the quotations were made ex-rights in the second half of December. Comparison of prices at that time with the present quotations shows a rise in C. A. Parsons from 48s to 56s 3d, and in A. Reyrolle from 87s 9d to £5, so that both shares kept their accustomed place in the forefront of the general advance in atomic power investments.

Preference Shares

Expectations of a coming all-round fall in interest rates have maintained a steady demand for preference shares offering the buyer good yields with sound security. Among those recently on offer in the electrical markets were Electric & Musical Industries Ltd., 4½ per cent preference at 15s, yielding 6 per cent, and the company's 5½ per cent shares at 17s 6d, yielding 6¼ per

Price Changes in

Company or Board	Nom. Value	Middle price 28th Jan.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1956 Highest	1956 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	79½	+1	3	3	3 15 6	80½	72½
Brit. Elec. 1974/77	100	77½	+1	3	3	3 17 6	79⅛	71½
Brit. Elec. 1976/79	100	81½	+1	3½	3½	4 6 0	84	74½
Brit. Elec. 1974/79	100	92½	+1	4¼	4¼	4 12 0	95	85½
Overseas Electric Supply								
Calcutta Elec.	£1	19/-		6†	6†	6 6 3†	20/9	18/6
East African Power	£1	20/6	+6d	7	7	6 16 6	21/3	19/-
Nigerian Elec.	£1	17/6		10	10*	11 8 6	21/-	17/-
Perak Hydro-Elec.	£1	14/3		10	10*	14 0 9	17/6	14/-
Equipment and Manufacturing								
Aberdare Cables	5/-	10/6	+3d	17½	17½	8 6 9	13/6	9/9
Aerialite	1/-	5/9	+3d	45	48	8 7 0	6/9	4/9
Allen, W. H.	£1	38/3	+1/3	20	10*	5 4 6	39/-	33/6
Aron Elec. Ord.	£1	52/6		15	15	5 14 3	56/-	52/6
Assd. Automation	10/-	20/6	+6d	10	5	2 8 9	19/-	15/-
Assoc. Elec. Ord.	£1	68/9	−3/9	14	15	4 7 3	85/6	57/6
Automatic Tel. & El.	£1	57/6	+1/3	15	15	5 4 3	72/6	50/-
Babcock & Wilcox	£1	80/9	+2/-	15	15	3 14 3	85/6	64/-
Baldwin, H. J.	2/-	5/-	+6d	20	20	8 0 0	5/-	3/9
Bakelite	10/-	22/-		16	16	7 5 6	34/-	21/3
Berry's Electric	5/-	5/9		—	10‡	8 14 0	6/6	5/9
British Aluminium	£1	66/3	−2/6	12	12	3 12 6	78/9	40/6
B.I. Callender's	£1	51/3		10	12½	4 17 6	54/3	45/-
B.I. Callender's 6% Pref.	£1	21/3		6	6	5 13 0	22/6	20/3
British Tabulating	£1	45/9	+6d	9	9	3 18 6	51/3	37/3
British Thermostat	5/-	26/3		20	25	4 15 3	31/9	24/6
British Vac. Cleaner	5/-	8/-		30	15*	9 7 6	8/9	6/-
Brook Motors	10/-	32/6		25	25	7 13 9	44/-	30/-
Brush Group	5/-	6/-	+1/-	10	10	8 6 9	7/9	4/6
Bulgin, A. F.	1/-	5/6	+6d	45	50	—	5/3	4/-
Burco Dean	5/-	9/-	+3d	22½	20	11 2 3	13/6	8/3
Chloride El. Storage " A "	£1	65/-	+5/3	17½	17½	5 7 9	73/6	55/-
Clarke Chapman	£1	135/-		20	22½	3 6 9	127/6	89/6
Cole, E. K.	5/-	19/-	+1/-	17½	17½	4 12 0	22/3	15/-
Cossor, A. C.	5/-	7/-	+3d	15	Nil	Nil	10/3	5/-
Crabtree	10/-	24/6		20	20	8 3 3	29/3	23/-
Crompton Parkinson Ord.	5/-	17/6	+2/6	16	16	4 11 6	15/-	12/3
De La Rue	5/-	18/6	+1/3	30	30	8 2 3	20/3	15/-
Decca " A "	4/-	30/-	+6d	56½	43¾*	5 16 9	44/9	23/3
Desoutter	5/-	28/-		25	30	5 7 3	32/9	25/9
Dewhurst	2/-	7/3	+3d	30	16¼*	4 9 9	7/6	5/3
Dictograph Tel.	2/-	7/3	+3d	20	20	5 10 3	7/3	5/6
Dubilier Condenser	1/-	5/9		25	30	5 4 3	5/9	3/6
Duport	5/-	18/9	+9d	23	25	6 13 3	21/6	13/9
E.M.I.	10/-	27/3	−9d	15	15	5 10 0	37/-	22/6
Electrical Components	5/-	7/3	+6d	25	25	8 12 6*	8/-	6/3
Elec. Construction	£1	25/-	+1/3	8½	8½	6 16 0	29/9	22/6
Elliott Bros.	5/-	28/9		17½	20‡	3 9 6	36/9	22/6
Enfield Cable Ord.	£1	14/-		Nil	Nil	Nil	19/3	13/-
English Electric	£1	52/6	−1/3	12½	12½	4 15 3	66/3	43/9
English Electric 3¾% Pref.	£1	13/6		3¾	3¾	5 11 0	14/6	12/6
Ericsson Tel.	5/-	38/6	−6d	20†	20†	2 12 0†	42/9	31/-
Ever Ready	5/-	31/-	−1/3	35	35	5 13 0	32/9	24/-
Falk Stadelmann	£1	36/9		17½	17½	9 10 6	45/9	35/6
G.E.C. Ord.	£1	56/3	+1/3	12½	14	4 19 6	65/6	41/3
G.E.C. 6½% Pref.	£1	23/-		6½	6½	5 13 0	23/9	21/3
General Cables	5/-	12/9	+1/6	30	30	11 15 3	13/9	11/3
Greenwood & Batley	£1	46/3		17½	17½	7 11 3	47/6	45/-
Hackbridge Holdings	5/-	20/9		25	30	7 4 6	24/6	18/9
Hackbridge & Hewittic	5/-	15/-		30	23*	7 13 3	22/-	13/9
Heatrae	2/-	4/-		15	15	7 10 0	5/1	3/9
Henley's	10/-	16/6		10½	11½	6 19 6	19/9	14/-
Holophane	5/-	24/6	+4/6	30	30	6 2 6	21/6	17/-

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.
* After scrip issue. † Free of income tax. ‡ Dividend indicated.

cent. Approximately the latter return has been available from Marryat & Scott 6 per cents at 19s. Johnson & Phillips 4½ per cent redeemable preference at 15s 3d, and Radio Rentals 5½ per cents at 18s 3d, both offer about 6 per cent on the money invested. On British Vacuum Cleaner 5½ per cents at 14s the yield is a little more than 7¾ per cent.

Further Improvements

While still focused to a large extent upon the inner circle of nuclear power companies, investment interest has lately become much more widely diffused over the general field of electrical engineering. Plessey have jumped back into prominence, putting on 6s 3d during the past week, to 69s 6d. Lancashire Dynamo added 1s 3d to the previous week's advance of 5s, reaching 43s 9d. Switchgear & Cowans and Brush each went up by 1s more, to 15s 6d and 6s respectively, and there were improvements of note in, among others, Electric Construction, T.C. & M., Laurence Scott, Ward & Goldstone, A. F. Bulgin and H. J. Baldwin. On hopes of easier conditions for the motor trade, Lucas rose to 32s 6d and S. Smith to 14s, while Chloride Electrical "A" put on more than 5s to 65s. Holophane were also outstanding at 24s 6d, and the radio group showed many gains.

Electrical Investments

Company or Board	Nom. Value	Middle price 28th Jan.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield% £ s d	1956 Highest	1956 Lowest
Equipment and Manufacturing—continued								
Hoover	5/-	29/9	+6d	70	50	8 8 0	39/3	23/-
I.C.I.	£1	43/3	+2/3	10	10	4 12 6	49/9	37/3
Intl. Combustion	5/-	22/3	+1/-	25	20*	4 10 0	25/-	15/3
Johnson & Phillips	£1	33/3	−6d	15	15	9 0 6	46/6	27/6
Lancashire Dynamo	£1	43/9	+1/3	15	11*	5 0 6	49/9	37/6
Laurence, Scott	5/-	16/3	+1/6	12½	15	4 12 3	16/9	13/3
Lister, R. A.	£1	28/3		9·3	10	7 1 6	35/3	24/6
London Elec. Wire	£1	45/9	+9d	12½	12½	5 9 3	52/9	42/6
Lucas, J.	£1	32/6	+1/3	7½	7½	4 12 3	40/3	28/9
Marryat & Scott	2/-	8/3		30	30	7 5 6	11/3	8/9
Mather & Platt	£1	55/-	+2/6	15	15	5 9 0	65/3	50/-
Metal Industries	£1	23/-	+6d	9	9	—	27/-	16/3
Midland Elec. Mfg.	£1	46/3		10	12½	5 8 0	48/6	43/6
Morphy-Richards	4/-	12/-	−6d	50	50	—	13/9	10/-
Murex	£1	70/9	+4/6	20	20	5 13 0	74/6	60/-
Newman Ind.	2/-	2/6	+3d	10	10	8 0 0	2/9	2/1
Oldham & Son	1/-	2/6		20	17½*	7 0 0	3/-	2/3
Parnall (Yate)	5/-	7/-	−3d	14	12	8 11 6	9/6	5/6
Parsons, C. A.	£1	56/3		10	10	—	—	—
Plessey	10/-	69/6	+6/3	27½	30	4 6 3	87/6	56/-
Pye "A" Deferred	5/-	16/3	−9d	12½	12½	3 17 0	21/3	13/3
Reyrolle	£1	100/-		15	16½	3 5 0	117/6	81/-
Rheostatic	4/-	9/-		18½	12†	5 6 9	—	8/3
Richardsons Westgarth	5/-	18/-	+3d	16⅝	16⅝	4 12 6	17/3	13/9
Scottish Cables	4/-	17/3	+6d	27½	27½	6 7 6	17/9	14/9
Smith (England), S.	4/-	14/-	+6d	17½	17½	5 0 0	14/3	10/6
Southern Areas	£1	18/9		10	7½	8 0 0	28/9	13/9
Strand Elec.	5/-	8/3	+6d	15	15	9 1 9	8/6	6/9
Sturtevant	5/-	25/-	+6d	14·4†	15†	3 0 0†	31/3	21/3
Sun Elec.	£1	42/6		20	25	11 15 3	42/6	33/9
Switchgear & Cowans	5/-	15/6	+1/-	20	25	8 1 3	17/-	12/9
Taylor Tunnicliff	5/-	13/3	+1/-	15	15	5 13 3	14/-	11/3
T.C.C.	10/-	33/9		25	25	7 8 3	45/-	33/9
T.C. & M.	£1	29/-	+2/-	8½	8½	5 17 3	34/-	24/-
Telephone Mfg.	5/-	6/6		10	10*	7 13 9	8/6	6/-
Thorn Elec.	5/-	18/9	−9d	15	15	4 0 0	22/6	15/-
Thornycroft	£1	33/9		15	12½	7 8 3	49/9	33/6
Tube Investments	£1	61/3		22½	15*†	4 18 0	70/6	50/9
Vactric	5/-	14/6	+6d	15	17½*	6 0 9	15/-	11/-
Veritys	5/-	9/3		12½	12½	6 15 3	10/-	6/9
Walsall Conduits	4/-	12/3	+6d	70	20*	6 10 6	13/6	10/9
Ward & Goldstone	5/-	38/9	+1/3	30	35	4 10 3	39/6	29/-
Watford	2/-	6/6	+3d	25	25	7 13 9	7/6	5/6
Westinghouse	£1	76/3	+1/3	18	18	4 14 6	100/-	67/6
West, Allen	5/-	13/6		15	15	5 11 0	14/6	11/3
Wolf Electric	5/-	17/6		20	20	5 14 3	26/3	17/6
Trusts, Transport and Communications								
Anglo-Portuguese	£1	22/9	+1/6	8	8	7 0 9	23/6	20/3
Brit. Elec. Traction: Def. Ord. "A"	5/-	20/-	+1/6	22½	22½	5 12 6	20/-	15/6
Cable & Wireless. Ord.	5/-	11/-		10	10	4 11 0	11/3	9/3
4% Loan	100	91½	+1	4	4	4 7 6	92½	88
Calcutta Trams	£1	25/-	−1/3	7½†	8½†	6 16 0†	27/6	23/-
Cape Elec. Trams	£1	15/-		8	8	10 13 3	20/3	15/6
Marconi Marine	£1	33/-	+1/-	10	10	6 1 3	34/-	31/-
Oriental Tel. Ord.	1/-	70/-	−1/3	16	—	—	90/-	66/3
Telephone Rentals	5/-	11/3	+6d	12½	12½	5 11 0	11/9	9/6

Shares on Offer

The 5s ordinary shares of Venner, Ltd., which attract attention in particular through the company's interest in parking meters, have been on offer lately at about 13s to yield 5¾ per cent on the last-paid dividend of 15 per cent. Bowthorpe Holdings have indicated a total dividend of 37½ per cent for the past year, on which basis there is a prospective yield of 6·1 per cent from the 2s shares at 12s 3d. A similar return is available from the 4s shares of A. H. Hunt (Capacitors) at 9s, and rather more from Electrical Apparatus 5s ordinary at 17s 9d. Ultra Electric 5s "A" shares have been available lately at 10s 3d, giving 7·3 per cent on the money. Returns of 8 per cent or more are shown on the 5s shares of Phœnix Telephone at 9s, and on Christy Bros. £1 ordinary at 16s.

S.M.F. (Holdings)

Formerly a company with mining interests, under the name of Surprise Mining & Finance, S.M.F. (Holdings) has been reorganised on new lines since the present management took over control nearly a year ago. Among the interests acquired in this period is a substantial investment in the Lee Beesley Group, specialists in industrial electrical equipment installations and electronic control devices. Before the transformation, the company was paying a regular 12½ per cent per annum, and the 4s shares were quoted around 5s. For 1956 the new management has lately declared a final dividend making a total of 75 per cent for the year, since when the quotation has been around 22s. Further acquisitions in the electrical engineering field and elsewhere were stated recently to be in the course of negotiation.

Transfer of Iron and Steel Functions

An Order in Council has been made transferring to the Minister of Power the functions relating to iron and steel hitherto carried out by the Board of Trade.

REPORTS and DIVIDENDS

The Westinghouse Brake & Signal Co., Ltd.—The main figures in the accounts for the year ended 29th September last were given in our issue of 18th January. In his circulated statement, Mr. A. R. S. Nutting (chairman) says that at the annual meeting to be held on 11th February a resolution will be submitted for approval to increase the authorised capital of the company from £3,500,000 to £8,000,000. The directors have in mind that further cash will be necessary during the current year to finance the group's increased activities, and they wish to be free to combine this with a capitalisation of some of the reserves which will bring the issued capital more into line with the capital employed in the business. Reviewing the activities of the various divisions, Mr. Nutting says that in the brake division special effort has been made in developments in design and manufacture and the result is an excellent order book for the home and overseas markets. Referring to the British Railways modernisation programme, he says that they have designed new signalling equipment necessitated by the adoption by British Railways of 25,000 V, 50 c/s, as the basis for electrification. Great technical progress has been made in the field of automatic control of marshalling yards, and they have substantial orders for this equipment. The orders from overseas markets for signalling have reached a large total in value.

In the rectifier division, one outstanding delivery has been the plating plant for producing tin plate at the Velindre Works of the Steel Co. of Wales. Expansion of the rectifier and semi-conductor business has continued to meet the heavy demands for rectifiers and rectification equipments at home and overseas. Exports have doubled in the last three years. Their germanium semi-conductor will be available this year, and there is continuous development of silicon semi-conductors. The output of the Chippenham works during the year under review was the highest on record, and the current year's output target has been stepped up still further. Mr. Nutting briefly reviews the work of the subsidiary companies, and in his concluding remarks says that the parent company's order books, home and export, are at record levels.

The British Tabulating Machine Co., Ltd.—The annual meeting was held on 25th January, Sir Cecil M. Weir (chairman) presiding. In his circulated statement, the chairman said that output of new electronically operated machines during the year under review had been doubled. Their efforts to step up the rate of technical progress included the establishment of two new research and development companies, one in the United States in conjunction with the Laboratory for Electronics in Boston, under the name of International Computers Corporation, and the other in the United Kingdom in conjunction with the General Electric Co., Ltd., under the name of Computer Developments, Ltd.

Veritys, Ltd.—In a letter to stockholders Mr. H. B. T. Wilde refers to his intention not to seek re-election to the board at the next annual meeting as he has attained the age of seventy years. He has resigned as chairman and the board has appointed Mr. G. S. Nott, managing director of the Lee Beesley Group, as chairman. Mr. Wilde states that he will act as deputy chairman until the next annual meeting. Mr. R. S. Blackledge and Mr. A. W. Hiley have placed their resignations as managing directors in Mr. Nott's hands, leaving him free to accept either or both resignations if he finds that desirable.

The Stockholders' Committee has considered Mr. Wilde's letter, and states that the action taken by him and certain directors has not been made with the approval of the Committee nor was it notified beforehand. It has decided to call immediately an extraordinary general meeting at which proposals will be put before the stockholders which will include the removal from the board of certain directors.

Richard Johnson & Nephew, Ltd., announce that permission has been obtained from the Treasury, through the Capital Issues Committee, for an increase in the issued ordinary share capital by the capitalisation of £1,800,000 of the general reserve and its distribution in the form of ordinary shares to existing members in the proportion of one additional share for every one now held. The shareholders will be asked to approve the issue at a meeting to be called in the near future and at the same meeting they will also be asked to approve an increase in the authorised share capital from £3,000,000 to £3,900,000.

The General Electric Co., Ltd., has announced an interim dividend of 4½ per cent on the £18 million ordinary capital as increased from £13,714,680 by a three-for-ten rights issue. A similar interim dividend was paid a year ago on the smaller capital.

The General Cable Manufacturing Co., Ltd.—The accounts as at 30th September last show that the group profit, including the profit earned by Britannic Cables, Ltd., was £233,076. No strict comparison with the previous period is possible as the financial year of Britannic Cables has been altered from 31st March to 30th September. The latest figures therefore include the profits earned by that company for eighteen months. After meeting all charges, but before providing for taxation, the net profit is £161,430. Taxation requires £89,574, and as already announced, a second interim ordinary dividend of 18 per cent is paid, making 30 per cent for the year (unchanged). For 1955 the figures were:—Group profit, £99,269; group net profit, before taxation, £74,075; taxation, £41,211.

The Lightfoot Refrigeration Co., Ltd., is paying an interim dividend of 3 per cent (against nil).

Lindley Thompson Transformer & Service Co., Ltd.—In the notice relating to this company's accounts in our last issue we stated that the trading profit for the year to 30th September last was £85,552. This should have read £80,552.

The Ebonite Container Co., Ltd., has declared an interim dividend of 7½ per cent (against 10 per cent).

New Companies

Ferranti Radio & Television, Ltd.—Registered 22nd January. Capital £100. To market, buy, sell, export, import, manufacture and deal in radio receivers, domestic television receivers, radiograms, etc. Solicitors: Allen & Overy, 3, Finch Lane, E.C.3.

Nuclear Graphite, Ltd.—Registered 22nd January. Capital £10,000. To carry on the business of machiners of graphite and carbon blocks for use in the construction of nuclear power stations, etc. Solicitors: Slaughter & May, 18, Austin Friars, E.C.2.

Mappinpoint, Ltd. — Registered 21st January. Capital £100. Electronic and automation engineers, etc. Regd. office: 156, Strand, W.C.2.

Liquidations

Electro Insulators, Ltd., electrical appliance merchants.—Winding up voluntarily. Liquidator, Mr. L. Ettling, Benefit Buildings, Moorhead, Sheffield, 1, appointed 11th January.

C. Lewis (Devon), Ltd., radio and electrical contractors.—Second dividend of 1s in the £, payable at the office of the liquidator, 50, The Terrace, Torquay.

Bankruptcies

S. L. Blythe, G. N. Bryan and **D. Mosley,** formerly trading together under the style of Kirkstall Radio & Electrical Service, at Kirkstall Lodge, Edwinstowe, Notts, radio and electrical engineers (separate application of D. Mosley).—Order made 13th December suspending bankrupt's discharge for three months until 13th March.

L. C. Sampson and **E. C. Tubb,** carrying on business in co-partnership under the style of Electro Radio Stores, at Fore Street, Gunnislake, Cornwall, electrical and television dealers.—Last day for receiving proofs for dividend 1st February. Trustee, Mr. H. Evans, 39, St. James's Street, London, S.W.1.

E. Newland, electrical contractor, 130, Grove Road, Chadwell Heath, Romford, Essex.—First dividend of 10s in the £, payable 7th February, at 18, Bentinck Street, London, W.1.

C. T. Boden, carrying on business as a wholesale electrical, hardware and fancy goods dealer, under the style of the High Peak Wholesale Electrical Supplies, at 5, Hartington Street, Derby, and carrying on business as a retail electrical, hardware and fancy goods dealer at "Anafon," Abergele Road, Old Colwyn, Flint.—Trustee. Mr. R. F. Bendall, 126, Colmore Row, Birmingham, 3, released 21st December.

F. Smith, 6, Imperial Buildings, Dale End, Birmingham, wholesale electrical accessories factor.—Last day for receiving proofs for dividend 9th February. Trustee, Mr. R. K. Clark, Somerset House. 37, Temple Street, Birmingham, 2, Official Receiver.

NEXT WEEK'S EVENTS

Organisers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged.

Monday, 4th February

BIRMINGHAM. — College of Technology, Gosta Green, 6 p.m. I.E.E. South Midland Centre. "Technical Development and Training in the U.S.S.R.," by G. S. C. Lucas and D. P. Sayers.

ILFORD.—Angel Hotel, 7.30 p.m. A.S.E.E. North East London Branch. "Review of Modern Lighting Techniques," by D. E. Mutch.

LEEDS.—Great Northern Hotel, 7.30 p.m. A.S.E.E. Leeds Branch. "Ball and Roller Bearings," by J. Warren.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Radio & Telecommunication Section. Informal evening on "The Importance of Research in Hearing and Seeing to the Future of Telecommunication Engineering," by Dr. E. C. Cherry.

Caxton Hall, S.W.1, 7 p.m. E.P.E.A. London Technical Group. "Oil Firing for Large Boilers," by G. J. Gollin.

Burlington House, W.1, 5.30 p.m. Society of Engineers. Inaugural meeting and presidential address, by E. C. Le Jeune.

MAIDSTONE.—Technical College, Tonbridge Road, 6.30 for 7 p.m. I.E.E. district meeting. "The Potentialities of Railway Electrification at the Standard Frequency," by E. L. E. Wheatcroft and H. H. C. Barton.

NEWCASTLE-UPON-TYNE. — King's College, 6.15 p.m. I.E.E. North-Eastern Radio & Measurements Group. "The Measurement of Earth-Loop Resistance," by Dr. G. F. Tagg.

County Hotel, Neville Street, 6 for 6.30 p.m. North East Electrical Club. "Tyne Keels and Collier Brigs," by H. R. Viall.

SHEFFIELD.—Royal Victoria Station Hotel, 7.30 p.m. A.S.E.E. Sheffield Branch. "Lighting for Production," by J. W. Howell."

Tuesday, 5th February

CAMBRIDGE.—Technical College, 6 for 6.30 p.m. I.E.E. East Anglian Sub-Centre. "Large Power Transformers," by E. T. Norris.

EDINBURGH.—Carlton Hotel, North Bridge, 7 p.m. I.E.E. South-East Scotland Sub-Centre. "The Control and Instrumentation of a Nuclear Reactor," by A. B. Gillespie.

HAMMERSMITH. — Windsor Castle Hotel, 134, King Street, 7.30 p.m. A.S.E.E. West London Branch. "Recent Developments in Television," by G. E. Partington.

LEEDS.—1, Whitehall Road, 6.30 p.m. I.E.E. North Midland Centre. "The Crystal Palace Television Transmitting Station," by F. C. McLean.

LONDON.—At the Institution of Electrical Engineers, Savoy Place, 5 p.m. Institution of Post Office Electrical Engineers, London Centre. "Engineering Stores—Estimating and Supplies," by C. J. Cameron.

21, Bloomsbury Street, W.C.1, 6.15 p.m. Association of Mining Electrical & Mechanical Engineers, London Branch. "Routine Maintenance of Electrical Apparatus in Collieries," by G. M. Harvey.

At the Royal Society of Arts, John Adam Street, 7 p.m. Incorporated Plant Engineers, London Branch. "Automation—the Maintenance Aspect," by Sir Walter Puckey.

LUTON.—Chamber of Commerce, George Street West, 8 p.m. A.S.E.E. Luton Branch. "General Application of P.F. Control," by F. T. Bartho.

MANCHESTER. — Engineers' Club, Albert Square, 6.15 p.m. I.E.E. North-Western Centre. "Some Aspects of Heat-Pump Operation, with particular reference to the Shinfield Installation," by Miriam V. Griffith.

READING.—The University, London Road, 7.15 p.m. A.S.E.E. Oxford, Reading & Districts Branch. "The 13th Edition of the I.E.E. Rules," by J. J. Looker.

Wednesday, 6th February

BELFAST.—College of Technology, 7.30 p.m. Belfast Association of Engineers. "The B.T.H. Project at Larne," by D. R. S. Turner.

BIRMINGHAM.—James Watt Institute, Great Charles Street, 7 p.m. Junior Institution of Engineers, Midland Section. The Kitimat Scheme film. (Joint meeting with the Institution of Water Engineers.)

EDINBURGH. — Y.M.C.A., 14, South St. Andrew Street, 6.15 p.m. I.E.S. Edinburgh Centre. "Lighting as an Effective Aid to Architecture," by H. E. Bellchambers, R. V. Mills and H. R. Ruff.

GLASGOW.—39, Elmbank Crescent, 7 p.m. I.E.E. South-West Scotland Sub-Centre. "The Control and Instrumentation of a Nuclear Reactor," by A. B. Gillespie.

39, Elmbank Crescent, 8 p.m. A.S.E.E. Glasgow Branch. Lecture.

HARRINGAY.—"Queen's Head," 677, Green Lanes, 7.45 p.m. A.S.E.E. North London Branch. "Radio Valves," by G. H. Gardner.

HOVE.—10, Queen's Gardens, 6.30 p.m. I.E.E. Southern Centre. "Developments in Lighting Techniques," by L. H. Hubble.

LEICESTER.—De Montfort Hall, 7.15 p.m. I.E.E. East Midland Centre. Faraday Lecture, "Nuclear Energy in the Service of Man," by Dr. T. E. Allibone.

College of Technology, 6.45 p.m. Institution of Heating & Ventilating Engineers, East Midland Branch. "School Heating," by J. H. R. Parris.

LONDON.—Savoy Place, W.C.2, 6 p.m. I.E.E. Education Discussion Circle. Discussion on "The Place of Liberal Studies in Sandwich and other Technological Courses," opened by E. H. Horrocks.

Savoy Hotel, 6.45 for 7.30 p.m. Institution of Heating & Ventilating Engineers. Annual dinner.

John Adam Street, Adelphi, 2.30 p.m. Royal Society of Arts. "Mining Education and Training," by I. C. F. Statham.

NEWCASTLE-UPON-TYNE. — King's College, College Road, 6.15 p.m. I.E.S. Newcastle-upon-Tyne Centre. "Lighting for Photography," by R. W. Unwin.

PAISLEY.—The Canteen of Thomas White & Sons, Ltd., 7.15 p.m. Institution of Works Managers, Paisley Group. "Computer Control of Machine Tools" and "General Principles of Electronic Systems," by G. S. Kermack.

PRESTON.—R.A.F.A. Club, East View, 7.30 p.m. A.S.E.E. Preston Branch. "Industrial Uses of a.c. Capacitors," by P. R. Coursey.

SWANSEA.—At the South Wales Electricity Board, The Kingsway, 6.30 p.m. I.E.S. Swansea Group. "Light and its Effect on Plant Growth and Egg Production," by A. E. Canham.

Thursday, 7th February

CARDIFF.—At the South Wales Electricity Board, The Hayes, 7 p.m. I.E.S. Cardiff Centre. "Architect's Approach to Lighting," by G. Grenfell Baines.

CROYDON.—Half Moon Hotel, Broad Green, 8 p.m. A.S.E.E. South London Branch. "Fluorescent Lighting—Modern Applications," by G. V. McNeill.

EDINBURGH. — Charlotte Rooms. I.E.E. South-East Scotland Sub-Centre. Joint dance with the Edinburgh & East of Scotland Association of the Institution of Civil Engineers.

GLASGOW.—39, Elmbank Crescent, 6.30 p.m. I.E.S. Glasgow Centre. "Lighting as an Effective Aid to Architecture," by R. H. Ruff, R. V. Mills and H. E. Bellchambers.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. Institution of Electrical Engineers. Graham Clark Lecture, "The Place of Engineering in University Education," by Sir Ifor Evans. (Joint meeting with the Institutions of Civil and Mechanical Engineers.)

2, Savoy Hill, W.C.2, 6.30 p.m. Chief Technical Assistants' Association. "Universities or Technical Colleges for Engineers?" by Dr. P. Dunsheath.

1, Birdcage Walk, S.W.1, 6 p.m. Institution of Heating & Ventilating Engineers. "Current Practice in School Heating," by L. Oliver.

MANCHESTER. — Engineers' Club, Albert Square, 7 p.m. I.E.E. North-Western Graduate & Student Section. "The Problems Created by Harmonics in Discharge Tube Circuits," by J. Lofts and W. Waring.

College of Technology, Sackville Street, 6.30 p.m. British Institution of Radio Engineers, North Western Section. "Electronics in Medicine," by R. F. Farr.

NOTTINGHAM.—Electricity Service Centre, Smithy Row, 5.30 for 6 p.m. I.E.S. Nottingham Centre. "The Use of Coloured Light," by H. Hewitt.

PETERBOROUGH.—White Lion Hotel, Church Street, 7.30 p.m. Incorporated Plant Engineers, Peterborough Branch. "Light and Lighting," by A. L. Berridge.

Friday, 8th February

BIRMINGHAM.—Regent House, St. Philip's Place, Colmore Row, 7 p.m. Society of Instrument Technology, Midland Section. "Electricity Systems Protection," by B. Copper.

BRISTOL.—Grand Hotel, 8 p.m. A.S.E.E. Bristol & West of England Branch. "High Frequency Heating Application," by A. Hogan.

CHELMSFORD.—Cannon's Restaurant, 8 p.m. I.E.E. London Graduate & Student Section. Dance.

LONDON.—21, Albemarle Street, W.1, 9 p.m. Royal Institution of Great Britain. "The Story of the Turbine, Steam and Gas," by Sir Claude Gibb.

Caxton Hall, S.W.1, 6.30 p.m. E.P.E.A. Southern Meter Engineers' Group. "Ultrasonic Cleaning Technique," by E. S. Broadbridge.

MANCHESTER. — Engineers' Club, Albert Square, 6.45 p.m. Manchester Association of Engineers. "The Post-War Trend of Power Station Plant Design," by F. J. Hutchinson.

Midland Hotel. Institution of Production Engineers, North Western Region. Annual dinner.

NEWCASTLE-UPON-TYNE.—At the Mining Institute, 6.15 p.m. North East Coast Institution of Engineers & Shipbuilders. "Ceramic Materials for High-Temperature Gas Turbines," by Dr. T. H. Blakeley.

SALE.—Locarno, Washway Road, 6.45 for 7.15 p.m. I.E.E. North-Western Utilisation Group. Annual dinner-dance.

Saturday, 9th February

LONDON. — I.E.E. London Graduate & Student Section. Visit to the Houses of Parliament (heating, ventilating and sound equipment), at 10.30 a.m.

Work Study and Industrial Engineering

The Work Study Society and the Society of Industrial Engineers have issued a new monthly journal entitled "Work Study and Industrial Engineering," the first issue of which (January) contains, in addition to regional news and meetings, articles on normal working time and process allowance, the effective use of manpower in agriculture, the technique of introducing a new materials handling method, method study, and work study and human relations. The journal is published by Management Publications, Ltd., Management House, 8, Hill Street, London, W.1, price 2s 6d.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 0d each including postage) will be obtainable after 6th February from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1951

2240. Elliott Bros. (London), Ltd.—Automatic correction of synchronous electric clocks or like time-indicating or time-recording devices operated from a.c. supply mains. 29th January, 1952. (767581.)

1952

1039. British Thomson-Houston Co., Ltd.—Electric discharge lamps. 24th November, 1952. (767392.)

5205. Soc. Anon. des Manufactures des Glaces et Produits Chimiques de St. Gobain, Chauny & Cirey.—Fluorescent electric discharge lamps. 27th February, 1952. (767391.)

12787. Parsons & Marine Engineering Turbine Research & Development Association, and Maxwell, D. C.—Means for cooling gas turbines. 19th May, 1953. (767800.)

30673. General Electric Co., Ltd., and Bayliss, A. J.—Electric pulse generator. 30th November, 1953. (767683.)

30675. General Electric Co., Ltd., and Ward, P. W.—Automatic telephone exchanges. 3rd December, 1952. (767684.)

32569. General Electric Co., Ltd., and Robinson, A. S.—Apparatus of the kind responsive to impulses amplitude modulated on to an electric carrier signal. 22nd December, 1953. (767500.)

1953

3075. Claude-General Neon Lights, Ltd.—Low pressure mercury vapour electric discharge tubes for emitting light. 28th January, 1954. (767395.)

4251. Philco Corporation.—Frequency changing circuits. 16th February, 1953. (767396.)

4381. Standard Telephones & Cables, Ltd.—Trigger circuits. 17th February, 1953. (767686.) 4382. Electromagnetic switches. 17th February, 1953. (767687.)

8289/91. British Electrical & Allied Industries Research Association.—Electric arc welding systems. 15th and 16th June, 1954. (767688/90.)

8530. Licentia Patent-Verwaltungs-Ges.—Telephone systems with a main exchange and a satellite exchange. 27th March, 1953. (767397.)

13711/2. General Electric Co., Ltd.—Apparatus for the measurement of phase distortion in electric circuits. 10th and 14th May, 1954. (767483/4.)

14993. British Tabulating Machine Co., Ltd.—Electronic calculating apparatus. 27th April, 1954. (767692.)

15017. General Electric Co., Ltd., and Bayliss, A. J.—Electric pulse generating apparatus. 24th May, 1954. (767685.)

16085. Neill & Co. (Sheffield), Ltd., J.—Ion-trap magnets for cathode-ray tubes. 17th May, 1955. (767566.)

21502. British Messier, Ltd.—Electromagnetically operated fluid control valves. 3rd August, 1954. (767823.)

21760. General Electric Co., Ltd., and Easter, B.—Thermionic valve oscillators. 29th July, 1954. (767485.)

22141. Crosfield, Ltd., J. F.—Electrical production of printing surfaces. 23rd July, 1954. (767505.)

22651. Standard Telephones & Cables, Ltd.—Travelling wave tube. 17th August, 1953. (767506.)

23154. Postmaster General.—Communication systems. 6th October, 1954. (767568.)

27969. Cinema-Television, Ltd.—Methods of securing electrodes to glass or ceramic rods and cathode-ray tubes including structures formed by the use of such methods. 1st November, 1954. (767590.)

28694. Electric & Musical Industries, Ltd.—Pulse separating circuits. 1st October, 1954. (767508.)

29689. Welwyn Electrical Laboratories, Ltd., and Whitfield, E. H.—Snap action switches. 24th January, 1955. (767591.)

30669. Metropolitan-Vickers Electrical Co., Ltd.—Electron emissive cathodes. 19th November, 1954. (767718.)

31234. Automatic Telephone & Electric Co., Ltd.—Alarm circuits for use in telemetering systems. 24th August, 1954. (767510.)

31410. Thomas & Baldwins, Ltd., R., and Davies, G. R.—Dynamometer wattmeters. 12th November, 1954. (767406.)

31810. Revo Electric Co., Ltd.—Electric discharge lamp fitting. 17th February, 1955. (767407.)

1954

592. English Electric Co., Ltd.—Electric connections. 7th January, 1955. (767832.)

1243. English Electric Co., Ltd.—Electric arc welding systems. 14th January, 1955. (Cognate application 8564, 24th March, 1954.) (767659.)

1459. General Electric Co., Ltd., and Easter, B.—Electric oscillators which are arranged to supply frequency modulated oscillations. 18th January, 1955. (767486.)

3404. Marrison & Catherall, Ltd.—Focusing magnet systems for cathode-ray tubes. 20th December, 1954. (767437.)

3652. British Thomson-Houston Co., Ltd.—Electrical waveguide systems. 8th February, 1955. (767518.)

4031. Plessey Co., Ltd.—Variable resistors. 11th February, 1955. (767579.)

6403. Westfalische Metall-Industrie Ges.—Enclosed spark discharge lamps for signalling. 4th March, 1954. (767519.)

7205. British Insulated Callender's Cables, Ltd.—H.v. electric cables and their manufacture. 11th March, 1955. (767836.)

7701. Electric & Musical Industries, Ltd.—Distributed amplifiers. 3rd March, 1955. (767520.)

7958. Soc. d'Eléctronique et d'Automatisme.—Electric analogue computer devices. 18th March, 1954. (Addition to 751602.) (767521.)

9123. Mullard Radio Valve Co., Ltd.—Transistor rectangular-wave generator circuits and the like. 1st February, 1955. (Cognate application 17224, 11th June, 1954.) (767727.)

9422. International Business Machines Corporation.—Production of photoelectric impulses. 31st March, 1954. (767728.)

9592. British Tabulating Machine Co., Ltd.—Electronic circuits responsive to bi-valued voltages on two or more input lines. 1st April, 1954. (767693.)

10375. British Thomson-Houston Co., Ltd.—Electric limit switches. 18th March, 1955. (767441.)

11793. Standard Telephones & Cables, Ltd.—Railway signalling equipment. 23rd April, 1954. (767732.)

12478. English Electric Valve Co., Ltd.—Television and like camera tube arrangements. 4th January, 1955. (767570.)

14070. Standard Coil Products Co., Inc.—Radio frequency amplifier. 13th May, 1954. (767526.)

14216. Mantel Metalworkers, Ltd.—Systems of ducting for electrical conductors. 16th May, 1955. (767442.)

14435. Bendix Aviation Corporation.—Mass spectrometer and electron multiplier arrangements. 17th May, 1954. (767527.)

14570. Fenn, L. E.—Electric cigarette lighters. 20th January, 1955. (767444.)

15078. Kolster-Brandes, Ltd.—Automatic gain control circuits. 20th May, 1955. (767735.)

15120. Bylock Electric, Ltd., and Judd, S. F.—Hair dryers. 23rd May, 1955. (767736.)

15728. Astral Switchgear, Ltd.—Multi-way electric terminal blocks. 26th May, 1955. (767571.)

15854. Western Electric Co., Inc.—Electron discharge devices and electron sources therefor. 28th May, 1954. (767446.)

16831. Metropolitan-Vickers Electrical Co., Ltd.—Electrical sawtooth waveform generators. 23rd May, 1955. (767606.)

16998. Marconi's Wireless Telegraph Co., Ltd.—Polarised radio mirrors. 18th May, 1955. (767531.)

18513. Plessey Co., Ltd.—Electric plugs and sockets. 23rd June, 1955. (767844.)

19233. British Thomson-Houston Co., Ltd.—Electric lamp bases. 30th June, 1954. (767846.)

19663. Brentford Electric, Ltd.—Combined refrigerating and water heating systems. 13th May, 1955. (767847.)

20749. Standard Telephones & Cables, Ltd.—Microwave transducer. 16th July, 1954. (767612.)

22320. Philips Electrical Industries, Ltd.—Ultra-high-frequency amplifiers. 30th July, 1954. (767753.)

25289. Metropolitan-Vickers Electrical Co., Ltd.—Insulator strings for h.v. conductors. 22nd July, 1955. (767415.)

24321. Siemens-Schuckertwerke Akt.-Ges.—Electrical measuring apparatus. 31st August, 1954. (Addition to 759047.) (767542.)

27124. British Petroleum Co., Ltd., Lamb, D. H. G. R., and Hoadley, E. W.—Means for protecting electric cables lying across roads. 26th August, 1955. (767574.)

27779. Santon, Ltd.—Rotary electric switches. 21st September, 1955. (767546.)

27815. Globe Industries, Inc.—Manufacture of stators for motors. 27th September, 1954. (767773.)

28540. Soc. Anon. des Chantier et Ateliers de St.-Nazaire Penhoet.—Riveted joint insulated electrically or thermally by a simple barrier on the side opposite to the upset head. 4th October, 1954. (767547.)

29395. British Thomson-Houston Co., Ltd.—Holders for double-ended tubular electric lamps. 12th October, 1954. (767425.)

30251. Uher, E.—Device for the regulation of electrical heating and de-icing equipment. 20th October, 1954. (767669.)

31537. Naamlooze Vennootschap Hollandsche Draad-en Kabelfabriek.—Pin and socket electric couplings. 1st November, 1954. (767549.)

31613. Allmanna Svenska Elektriska Aktiebolaget.—Arrangement in poly-phase networks provided with means for high speed reclosing. 2nd November, 1954. (767427.)

33773. Raytheon Manufacturing Co.—Apparatus for controlling microwave energy propagation. 22nd November, 1954. (767783.)

34397. Palnut Co.—Sheet metal nut for use with a screw adjustable electrical circuit device. 26th November, 1954. (767786.)

34419. Radio Corporation of America.—Cathode-ray beam information storage tubes. 26th November, 1954. (767627.)

36447. Heywood, J. E.—Sequence control circuits more particularly for electronic computers. 16th December, 1954. (767431.)

36617. Compagnie Telma.—Eddy current apparatus and in particular braking devices of this type. 17th December, 1954. (767873.)

37118. Philips Electrical Industries, Ltd.—Automatic volume control circuits in wireless receivers. 22nd December, 1954. (767633.)

1955

71. Westinghouse Electric International Co.—Cathode-ray tubes. 3rd January, 1955. (767554.)

[*Concluded at foot of page* 225

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Australia.—Public Works Department, Port Moresby. 12th February. Hydro-electric generating equipment ranging from 5-400 kVA. (E.S.B. 1897/57. Ten/23812.)*

Burma.—Union Purchase Board. 19th February. 36 battery chargers. (E.S.B. 1791/57. Ten/23797.)* Four 5 kW and three 10 kW, 15 kW and 22 kW alternator sets. (E.S.B. 1793/57. Ten/23786.)*

Dudley.—Borough Council. 14th February. Street lighting equipment. (See this issue.)

Durham.—County Council. 9th February. Electrical installation workshop equipment for Bishop Auckland Technical College. G. H. Metcalfe, director of education, Shire Hall, Durham.

Formosa.—Central Trust of China, Purchasing Department. 25th February. Eight fork-lift trucks. (E.S.B. 2203/57.I.C.A. Ten/23849.)*

India.—Government of Mysore. 12th February. 33 kV a.c.s.r. conductor and conductor accessories. (E.S.B. 2257/57. Ten/23869.)* Auxiliary l.v. switchgear. (E.S.B. 2259/57. Ten/23885.)* 21st February. 33 kV conductor and conductor accessories. (E.S.B. 2256/57. Ten/23868.)*

Government of Madras. 16th February. A.c.s.r. conductor and accessories. (E.S.B. 1849/57. Ten/23790.)* 15th March. 110 kV double and single circuit transmission lines. (E.S.B. 1848/57. Ten/23794.)*

Director General of Supplies and Disposals. 19th February. Hard drawn electrolytic high conductivity bare copper conductor. (E.S.B. 2087/57. Ten/23855.)* Water cooling plant. (E.S.B. 2002/57. Ten/23847.)*

Madhya Pradesh Electricity Board. 20th February. Pumping and water treatment plant for Korba thermal power station. (E.S.B. 1875/57. Ten/23793.)*

Government of Bombay. 23rd April. 110 and 220 kV out-door switchgear. (E.S.B. 1876/57. Ten/23820.)*

Merthyr Tydfil.—Borough Council. 16th February. Electrical goods for one year ending 31st March, 1958. Borough surveyor, Town Hall.

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

Middlesbrough.—Tees Valley Water Board. 19th March. Electrically-driven vertical spindle centrifugal pumping plant at Ormesby. T. S. R. Winter, engineer and general manager, Corporation Road, Middlesbrough.

Northern Ireland.—City Electricity Department. 22nd February. Electrical equipment including cables, street lighting fittings, water heaters, fuse units, etc. (See this issue.)

Norwich.—City Council. 11th February. Electric lamps and torch batteries for the year ending 31st March, 1958. H. C. Rowley, city engineer, City Hall.

Pakistan.—Department of Supply and Development. 11th February. Two submersible pumping sets. (E.S.B. 1989/57. Ten/23838.)*

Philippines.—National Power Corporation, Manila. 19th February. Power conductors, ground wires, insulators and accessories for the Binga-Manila 230 kV transmission line. (E.S.B. 1960/57. Ten/23857.)*

Pontypool.—U.D.C. 19th February. Street lighting equipment. (See this issue.)

Rhodesia and Nyasaland.—City of Bulawayo. 20th February. P.v.c. insulated and bare copper conductors and l.v. cables. (E.S.B. 1870/57. Ten/23822.)*

South Africa.—Union Tender and Supplies Board. 21st February. Cap lamps. (E.S.B. 2412/57. Ten/23890.)* Radio valves. (E.S.B. 2350/57. Ten/23896.)* Wire carrier telephone system. (E.S.B. 2348/57. Ten/23887.)*

Tynemouth.—Borough Council. 18th February. Electric lamps, lanterns, columns, and fittings, etc., for the year ending 31st March, 1958. D. M. O'Herlihy, borough surveyor, 16, Northumberland Square, North Shields.

Walthamstow.—Borough Council. 11th February. Conduit, cables, and lamps for the year ending 31st March, 1958. Borough engineer, Town Hall, E.17.

Watford.—Borough Council. 18th February. Electric lamps and tubes for the year ending 31st March, 1958. Borough engineer, Town Hall.

ORDERS PLACED

Bexhill-on-Sea. — Corporation. Recommended. Lanterns, brackets and ancillary equipment, columns and the installation of the lighting system, for the third stage of the trunk road lighting scheme (£4,973).—A.E.I. Lamp & Lighting Co.

Bootle.—Corporation Housing Committee. Electrical installations in 34 dwellings on the Park Lane estate (£1,143).—Hardacre & Maltpress. Electrical installations in 43 dwellings at Derby Road (£1,489).—S. H. Gillies & Co.

Newcastle-on-Tyne. — Regional Hospital Board. Rewiring of wards at Thorpe Maternity Hospital (£1,391).—E. Dixon Barker & Son. Electrical work at Middlesbrough General Hospital (£1,287).—F. Shepherd & Son. Electrical work at the General Hospital, Carlisle (£3,740).—D. Thomson & Sons.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors

Alnwick.—Houses (30) on the Barresdale site; G. Beatty, town surveyor.

Aylesbury.—Houses (84), Craigwell Avenue; Everyman's Homes, Ltd., 123, Pall Mall, London, S.W.1.

Barry.—College of Further Education; E. Evans, county architect, Glamorgan County Hall, Cardiff.

Bedford.—Houses (95), in two contracts, Putnoe estate; F. W. Dawkes, borough surveyor, Newnham House, Horne Lane.

Kingsbrook County Primary Infants' School; county architect, Bedford.

Billingham-on-Tees.—Houses (97); E. Shaw, U.D.C. surveyor, Council Offices, Haverton Hill-on-Tees.

Birkenhead.—Block of offices, Cleveland Street, for Borough Treasurer's Department (£90,000); borough architect, 3, Conway Street.

Birmingham.—Shops, showrooms and offices, Exchange Buildings site, Stephenson Place; blocks of shops and offices on the Theatre Royal site, etc.; Cotton, Ballard & Blow, architects to developers, Cavendish House, Waterloo Street, Birmingham, 2.

Bradford.—Works and offices, Bolling Road; Drum Engineering Co., Ltd., Humboldt Street.

Braughing.—Houses (36), Buntingford and High Wych; R.D.C. surveyor, Bridgefoot House, Buntingford.

Brentford.—Shops, flats and offices in Brentford High Street; W. F. Church, town clerk, Town Hall, Chiswick, London, W.4.

Brierley Hill.—Houses (184), on various sites; J. R. Moore, housing director to U.D.C., Civic Buildings.

Bristol.—New buildings for Bristol Grammar School, University Road; F. W. Wills & Sons, architects, 15, Orchard Street.

Brodsworth.—Home for old people (£40,445); county architect, Wakefield, Yorks.

Burton-on-Trent.—Block of flats (43), communal laundry and garages; borough architect.

Cardiff.—Secondary modern school, Fairwater; Smith, Wilson & Cox, architects, 103, Bute Street.

Chelmsford.—Administrative offices, central stores, etc., Widford industrial estate (£209,294), for the County Supplies Department; H. Conolly, county architect, County Hall, Chelmsford.

Chesterfield.—Houses (300), Wingerworth estate and (18), Newbold estate; borough architect.

Chester-le-Street.—Houses (104), West Lane, Cleveland Avenue; W. Ridley, U.D.C. surveyor, Council Chambers, Front Street.

Consett.—Modern school (£151,000); R. C. Williamson, Ltd., builders, Station Works, Rowlands Gill, Co. Durham.

College of Further Education; county architect, South Street, Durham.

NEW PATENTS (*continued from page 224*)

1015. British Insulated Callender's Cables, Ltd.—Electric cables. 11th January, 1956. (Cognate application 20919, 19th July, 1955.) (767577.)

1341. Electric Storage Battery Co.—Electric batteries. 17th January, 1955. (767883.)

4460. Westinghouse Electric International Co.—Electric surface heating or cooking units. 15th February, 1955. (767887.)

4616. Haupt, M.—Post for electric fences. 16th February, 1955. (767795.)

5696. Standard Telephones & Cables, Ltd.—Selenium rectifier. 25th February, 1955. (767796.)

5705. International Business Machines Corporation. — Electronic multiplying machines. 25th February, 1955. (Addition to 767708.) (767709.)

6012. Kaljot, E. S.—Electric batteries. 1st March, 1955. (767470.)

7105. Schaffler-Glossl, J., and Schaffler-Glossl, H.—Delay setting units for electrical detonators. 10th March, 1955. (767896.)

8174. Dynamo-electric igniting machine. 21st March, 1955. (767648.)

7266. Metropolitan-Vickers Electrical Co., Ltd. (Compagnie Français Thomson-Houston).—Manufacture of travelling wave tubes. 11th March, 1955. (767563.)

7535. Vacuum Research (Cambridge), Ltd.—Electric heating elements and processes. 15th March, 1955. (767899.)

8023 and 8864. Hoover, Ltd.—Suction cleaners. 18th and 28th March, 1955. (767647 and 767799.)

8971. Philips Electrical Industries, Ltd.—Contacts of electric switch means. 28th March, 1955. (767479.)

12432. Allmanna Svenska Elektriska Aktiebolaget.—Winding protection for coils. 29th April, 1955. (767919.)

Coventry.—School, Henley Road, and shops (7), Wood End, Bell Green; planning officer, Bull Yard.

Crewe.—New hostel (£72,575), for Crewe County Training College; J. G. Kellett, director of education, City Road, Chester.

Dorking.—Houses (160) for Gatwick Airport personnel; clerk to R.D.C., Brookmead, Dorking.

Droitwich.—Houses (42), Ombersley and Crowle; surveyor, Rural Council Offices, Ombersley Street.

Durham.—Six cultural centres for miners for the Durham Coal Board (£300,000); N.C.B. Architects' Department, Ashfield Towers, Gosforth, Northumberland.

Edinburgh.—Residential building at Salisbury Green (£285,000); University Court, Chalmers Street.

Felling.—Four-storey flats in the Wellington Street re-development area; R. Morton, U.D.C. surveyor.

Filey (Yorks).—Methodist church and Sunday school at Hunmanby; B. W. Blanchard, architect, 34, George Street, Hull.

Fleetwood.—Church, Fleetwood Road; Brown & Jackson, Ltd., builders, Elm Street.

Frimley.—Junior school (£54,265); J. Harrison, Surrey county architect, County Hall, Kingston-on-Thames.

Gateshead.—Houses (80) at Ventnor Gardens for the T.C.; Dorran Construction, Ltd., builders, Perth.

Great Yarmouth.—Factory and extensions to existing premises at South Denes; Hartmann Fibre Co., Ltd., 5, Copthall Court, London, E.C.2.

Guildford.—Bottling stores, Woodbridge Meadows estate; Friary, Holroyd & Healy's Breweries, Ltd., Commercial Road.

Heywood.—Houses (150) at Heady Hill; A. Middleton, borough engineer, Municipal Buildings.

Hounslow.—Flats (94), Great West Road; Bell Homes, Ltd., Golden Court, Richmond, Surrey.

Ilford.—Motor showrooms, service depot, flats, etc., Eastern Avenue; Jessups (Romford), Ltd., London Road, Romford.

Jarrow.—Houses (400) in the Queen's Road area; H. W. T. Perkins, borough engineer, Town Hall.

King's Lynn.—Church, Newland Avenue; H. Guy Bishop, architect, Paradise Chambers.

London.—Dwellings (195), West Hill, Putney; Sir Lancelot Keay, Basil G. Duckett & Partners, architects, 80, Wimpole Street, W.1.

Departmental store, Tivoli Theatre site, Strand; Peter Robinson, Ltd., Oxford Circus, W.1.

Flats (48), Grove Road and Mortlake High Street, Barnes; borough engineer.

Offices and showrooms, Great Marlborough Street, Mayfair; A. Carden Pool & Partners, surveyors, 50, Lincoln's Inn Fields, W.C.2.

Office block, Berkeley Square and Bourdon Street, Mayfair; F. G. Minter, Ltd., 4, Buckingham Gate, S.W.1.

Loughborough.—De Lisle R.C. Secondary Modern School (£120,000) at Thorpe Hill; Sandy & Norris, architects, Castleberg Studio, Newport Road, Stafford.

Maidstone.—Technical school for boys, Oakwood Road; Kent county architect, Springfield, Maidstone.

Newcastle-upon-Tyne.—Primary schools at Coxlodge, Gosforth, Longbenton, and Newbiggin; county architect, County Hall, Newcastle.

Primary school at Kenton; Turley & Williamson, 46, Jesmond Road.

Factory, warehouse and offices, Blandford Street, E. Massey, Ltd.; Stephenson & Gillis, Saville Row Chambers.

Newhaven.—County secondary school (£116,800); East Sussex county architect, County Hall, Lewes.

Newton Aycliffe.—Junior school for Durham C.C. (£60,000); Middleton & Co., contractors, Haughton-le-Skerne, near Darlington.

Northallerton.—Boys' modern school (£151,000); county architect, County Hall, Northallerton.

Northern Ireland.—Maternity and child welfare clinic, Cupar Street, Belfast (£126,000); city surveyor, City Hall.

Norwich.—Dwellings (98), Heartsease estate; city architect.

Nottingham.—Chemistry block (£750,000), and agricultural block (£200,000), at the University, for Senate; Basil Spence & Partners, architects, 48, Queen Anne Street, London, W.1.

Okehampton.—Houses (46) at Wonacotts Meadows; George Brown & Partners, architects to B.C., Brunel House, College Green, Bristol, 1.

Ponteland.—Block of modern shops and flats at Darras Hall; Hindmarsh, Hepple and Bourn, estate agents, 61, Westgate Road, Newcastle-on-Tyne.

Romford. — Broxhill Secondary School (£150,000); H. Conolly, Essex county architect, County Hall, Chelmsford.

Salisbury.—Houses and flats (51), Bishopdown estate; J. Prichard, builder, 34, Chipper Lane.

Scarborough.—Flats (27), Regent Street; H. V. Overfield, borough engineer.

Sheffield.—District College of Further Education, Granville Road; city architect.

Houses (35), Duke Street; Reeves Charlesworth, Ltd., 27, Wilkinson Street.

Smethwick.—Laboratory; Henry Wiggin & Co., Ltd., Vittoria Street.

South Shields.—Factory for the Falcon Murest Manufacturing Co., Ltd.; R. Collins, architect, St. Hilda Street.

Southampton.—Warehouse and offices, St. George's Road; Fowler, Grove & Haggar, architects, 140, Lodge Road.

Southend-on-Sea.—Eastwood High School for Girls; S. E. Moss, Ltd., builders, Hill Works, St. Fabian's Drive, Chelmsford.

Stanion.—Houses (106); W. Strachan, builder, High Street, Stanion, Northants.

Stanmore.—Primary school, Green Lane; H. Pickrill, Ltd., builders, 24, Canning Road, Wealdstone.

Sunderland.—Houses (59) on the Lawrence Street clearance area; J. Prentice, builder, Leeds Street.

Swindon.—Research laboratories; Metal Box Co., Ltd., The Langham, Portland Place, London, W.1.

Tewkesbury.—Houses (67) at Canterbury Leys, Ashchurch Road; Rainger, Rogers and Smithson, architects to B.C., Glenmore Lodge, Wellington Square, Cheltenham.

Wallsend.—Eight-storey flats in Ropery Lane (£298,000); Wimpey & Co., Ltd., contractors, Orchard House, Newcastle-on-Tyne.

West Hartlepool.—Works extensions on a seventy-acre site for the South Durham Steel & Iron Co., Ltd., Cargo Fleet Ironworks, Middlesbrough.

Weymouth.—Dwellings (36), Dorchester Road; borough engineer.

Whickham.—Residential hotel; A. Watson, Ltd., The Knowles, Front Street, Whickham, Gateshead.

Worthing.—Bungalows (102), Cotswold estate; Haywards, Ltd., 26, Regency Square, Brighton.

TRADE MARKS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 23rd February:—

No. 757,842 (design). Class 9. Electrical instruments, measuring instruments and parts. —Southern Instruments, Ltd., Frimley Road, Camberley, Surrey.

MANDAW (design). No. 758,728. Class 11. Torches and electric lamps and electric lamp bulbs.—Ever Ready Co. (Great Britain), Ltd., Hercules Place, Holloway, London, N.7.

Ceylon's Electrical Imports

ELECTRICAL goods valued at Rs 32·8 million were imported by Ceylon in 1955, showing an increase of 9 per cent as compared with 1954. The principal products are shown in the accompanying table. In spite of increasing competition prospects of an expansion of electrical trade seem to be favourable. Reports indicate that the International Bank for Reconstruction and Development is inclined to make another loan of Rs 100 million available to cover the foreign exchange costs of a further stage of the Laxapana hydro-electric scheme. A previous loan of Rs 91 million was granted by the Bank for similar purposes. (1 rupee = 1s 6d.)

CEYLON'S ELECTRICAL IMPORTS, 1954-55 (Thous. rupees)

Class	1954	1955
Transformers, convertors and parts	1,922	988
From United Kingdom	1,898	105
,, West Germany	4	874
Generators, alternators and dynamos	743	812
From United Kingdom	413	756
,, West Germany	305	24
,, United States	25	20
Motors	773	814
From United Kingdom	734	240
,, West Germany	8	5
,, United States	14	2
Control and switchgear	1,705	599
From United Kingdom	1,589	570
,, West Germany	38	28
Cooking and heating appliances	535	611
From United Kingdom	483	405
,, West Germany	16	20
,, Switzerland	6	39
Wires and cables, rubber insulated	1,445	1,532
From United Kingdom	1,294	1,510
,, West Germany	136	17
Ditto, other insulated	2,005	2,886
From United Kingdom	1,915	1,490
,, Canada	16	26
,, West Germany	54	149
,, Holland	14	983
,, Italy	1	231
Fluorescent tubes	137	149
From United Kingdom	111	119
,, Holland	35	13
,, United States	19	9
Electric torches	1,040	1,076
From Hongkong	967	1,003
,, United States	65	69
Torch bulbs	177	266
From Hongkong	43	57
,, Holland	119	202
Other lamp bulbs	833	941
From United Kingdom	670	634
,, West Germany	73	114
,, Holland	73	105
Batteries, dry cell, radio	903	1,734
From United Kingdom	783	1,406
,, India	109	311
Ditto, other than radio	3,972	4,201
From United Kingdom	702	508
,, Singapore	3,047	3,377
Radio receivers	2,852	4,184
From United Kingdom	1,532	1,962
,, West Germany	292	961
,, Holland	978	1,205
Radio transmitting equipment	268	396
From United Kingdom	94	255
,, United States	174	42
Radio components	1,553	736
From United Kingdom	1,212	456
,, Holland	137	179
,, West Germany	47	33
Telephone and telegraph apparatus	1,058	682
From United Kingdom	1,026	616
Total all countries	30,100	32,806